

Geost Shaw
1926

THE WILEY FARM SERIES

EDITED BY

A. K. GETMAN

SPECIALIST IN VOCATIONAL AGRICULTURE, NEW YORK STATE
DEPARTMENT OF EDUCATION

AND

C. E. LADD

DIRECTOR OF EXTENSION, NEW YORK STATE COLLEGE
OF AGRICULTURE

DAIRY CATTLE

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DAIRY CATTLE

SELECTION, FEEDING AND MANAGEMENT

BY

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WILBER JOHN FRASER

OUR TEACHER, COLLEAGUE AND FRIEND;

A PIONEER, A BLAZER OF NEW TRAILS

AND ONE OF THE TRUEST FRIENDS

THE DAIRY INDUSTRY HAS EVER KNOWN

TO HIM,

THIS BOOK IS DEDICATED

THE AUTHORS

PREFACE

IT is the aim of this book to make available to vocational-school students and dairy farmers the most practicable methods of selecting, feeding, and caring for dairy cattle. These methods are based upon the proved and tested practice of successful dairymen and upon the results of scientific investigations, some of which are so recent that the data have not yet been published.

In accordance with the general plan for the books of the WILEY FARM SERIES, the authors have organized the content on the "doing," or "operative," basis. All directions have been given in a simple and concise manner so as to aid students and farmers to secure accurate information without an extensive search through scientific literature. The complete analysis of this functioning content appears in the Table of Contents. This outline will serve to make the volume more useful both as a text for study and as a source book for mature practicing farmers.

The authors are mindful of the inadequacy of this volume to meet all the vocational needs of students of dairy cattle enterprises in all parts of the United States. Within the limits of one volume, they have sought to include specific suggestions and recommendations in the major phases of these enterprises. At the close of many chapters are included outlines for "Community Studies." The discriminating observer will readily appreciate that these are merely suggestive. Teachers are urged to modify these outlines to meet local conditions, and to prepare additional studies as an instruction device to aid pupils in gaining first-hand knowledge of the actual practices of the successful dairy farmers of the region in which they live.

The authors wish to express their appreciation of the courtesy extended by the University of Illinois and by Mr. J. C. Allen of West La Fayette, Indiana, in permitting the use of photographs. They are also indebted to Miss Florence E. Smith and Mrs. Paul H. Tracey for a critical reading of the manuscript.

THE EDITORS AND AUTHORS.

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DAIRY CATTLE

CHAPTER I

SHALL I BE A DAIRYMAN?

Agriculture is the business of food production. Its products, in one form or another, supply the nourishment which makes our bodies grow and furnishes the energy that enables us to work and to play. The food products of agriculture may be divided into two general classes, based upon the manner in which they are used for human food. The separation on this basis is into primary and secondary foods. Primary foods are those which are eaten directly, requiring no special treatment other than cooking. Some examples are wheat, corn, oats, barley, potatoes, fish, and oysters. Secondary foods are almost entirely the products of animals and have been produced as a result of the consumption of primary feeds by these animals. Meat, milk, eggs, and honey are examples of secondary foods.

Primary foods, when measured in terms of total energy, constitute approximately 61 per cent of all of the foods which we consume, whereas secondary foods, evaluated on the same basis, make up about 39 per cent of our diet. Measured in terms of protein, carbohydrates, and fat, secondary foods supply approximately as much protein, one-sixteenth the amount of carbohydrates, and five times as much fat as primary foods. While primary foods have an advantage from a quantitative stand-

point, it remains a question whether or not they are as important from a qualitative basis as secondary foods.

The dairy industry is a division of agriculture, and is concerned with the production of an extremely valuable secondary food. Milk is a food just as meat and potatoes are foods, though it is not always so considered. In fact, milk is more nearly a balanced food for the needs of the human body than either meat or potatoes.

Of all the foods that we eat, milk is the most easily and completely digested. It contains all of the substances known to be necessary for growth and development except one, and that one (glycocoll) can be produced by the body itself from the other substances which milk contains. Milk is also rich in the mineral substances that are necessary for bone formation and for controlling certain of the body functions. It is slightly deficient in iron, and were milk used as the sole diet it would be necessary to add more of that substance. The vitamins which are known to be necessary for normal growth and development are found in milk.

Since the dairy industry is concerned with the production of so complete and so valuable a food, it seems almost certain that it will be an abiding industry and one that will grow somewhat in relation to the growth in population.¹ Any person who considers entering the field of dairy production should acquaint himself with the difficulties connected with the business, as well as the peculiar advantages of this industry.

1. FACTORS THAT COMMEND THE INDUSTRY

The fact that so many dairymen and farmers find the production of milk and cream sufficiently profitable to continue in the business indicates that there are certain factors or advantages which have made the industry attractive to them.

¹ See general information at the end of this chapter for the rate of growth of population and ratio of number of dairy cattle to population in the United States.

FOOD EQUIVALENTS

(FUEL
VALUE)

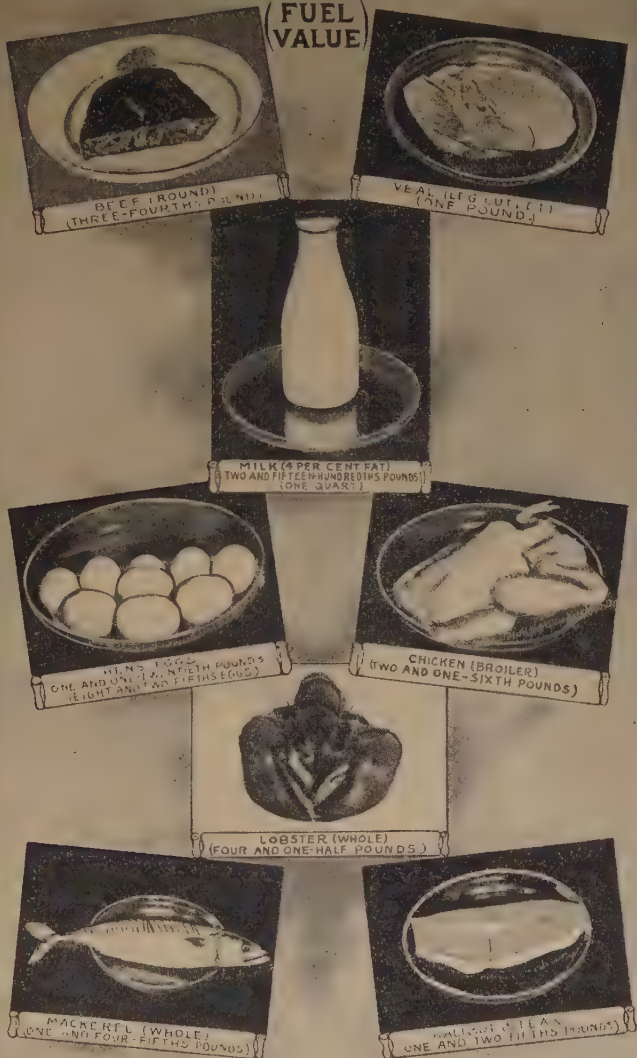


FIG. 1.—MILK IS AN EXCELLENT FOOD

The amounts of various food products of animal origin equivalent in energy value to one quart of 4 per cent milk. Compute the cost of each of these products in your local market.

Advantages accorded the industry:

- A. Good dairy cows are efficient producers of human food.
- B. Dairy farming tends to conserve the fertility of the soil.
- C. Dairy cattle yield a high cash return for roughages, pasture, etc.
- D. Dairy cattle furnish a home market for farm products.
- E. Dairying furnishes a market for labor.
- F. It provides a continuous cash income.

A. Good dairy cows are efficient producers of human food.—

If it became a question of maintaining the largest number of people on a given area, best results could be accomplished by feeding the products of that area as primary foods. Feeding primary feeds to animals and using the animal products produced thereby for human consumption does not ordinarily result in the most efficient utilization of food products. Animals, however, vary widely in the relative efficiency with which they are capable of converting primary feeds and fodders into secondary food products. This fact is illustrated in Table I in which certain of our farm animals, as well as a number of our more common farm crops, are compared as to the efficiency of the foods produced.

The acre is taken as the unit of production, and in the case of animals it is assumed that the crops produced are such as to supply the necessary nutrients for maximum production. In certain instances this means dividing the area and growing two or more crops in order to provide the proper nutritive ratio for the animal considered.

From a study of Table I, it will be observed that the dairy cow produces, in the form of milk, more human food from

TABLE I

HUMAN FOOD FROM AN ACRE OF FARM CROPS—UTILIZED AS PRIMARY AND SECONDARY FOODS *

	Yield	Yield	Human Food per Acre	
			Digestible protein	Energy
	Bushels	Pounds	Pounds	Therms
Primary Foods:				
<i>Crop</i>				
Corn.....	35	1960	147.0	3124.2
Irish potatoes.....	100	6000	66.0	1908.0
Wheat.....	20	1200	110.4	1788.0
Rice (polished).....	40	1086	50.0	1581.2
Soybeans.....	16	960	294.7	1534.0
Peanuts.....	34	524	126.2	1265.0
Oats.....	35	784	89.4	1254.4
Secondary foods:				
<i>Dairy Product</i>				
Milk.....		2190	72.3	711.8
Cheese.....		219	56.7	427.0
Butter.....		99	1.0	355.3
<i>Meat</i>	Live weight			
Pork.....	350 lb.	273	22.7	672.9
Poultry.....	267 lb.	171	33.0	178.7
Mutton.....	205 lb.	113	14.7	137.3
Eggs.....	122.4 doz.	184	24.6	132.2
Beef.....	216 lb.	125	18.5	130.0

* U. S. D. A. Farmers' Bul. 877, 1917.

the products of one acre of land than does any other farm animal. This is true whether the measure be digestible protein or therms of energy. It will be noted that the hog ranks second

and that it is much more efficient than any other meat-producing animal. These facts should suggest that the dairy cow and the hog constitute a desirable combination. This is especially true where cream is produced and skim milk fed on the farm.

Not only is the dairy cow supreme in the efficiency with which she is capable of producing human food and in the quality of her product, but she ranks high, as well, in total production. Chart 1 shows the proportion of the secondary foods produced by different classes of farm animals.

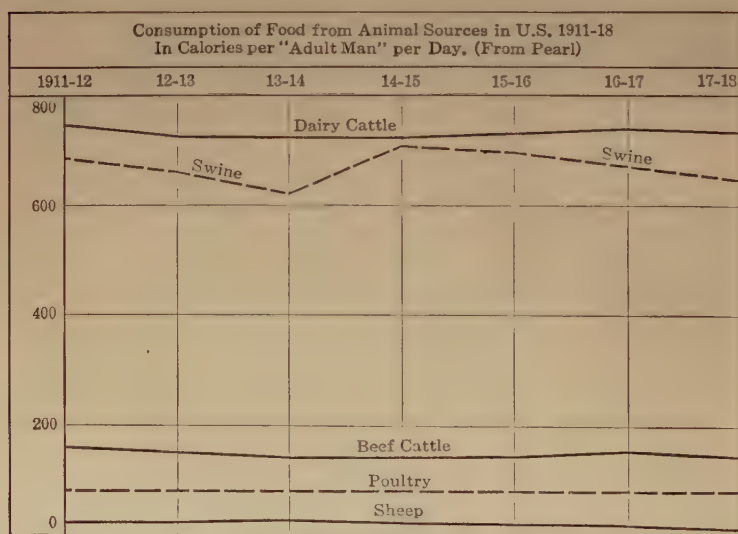


CHART 1.—PROPORTION OF SECONDARY FOODS PRODUCED BY DIFFERENT FARM ANIMALS

Besides dairy products, dairy cattle furnish about one-third of the total beef, and this fact was considered in making up the chart.

From a study of Chart 1, it will be observed that the products of the dairy cow, including veal, constitute a greater proportion of the foods of animal origin than do the products of any other domestic animal. In fact, the cow produces almost one-half (44 per cent) of this type of food.

There can be no question as to the importance of the dairy cow considered from the standpoint of quality of product, efficiency of production, or total amount of food produced. Her position among food-producing animals remains unchallenged.



FIG. 2.—DAIRY PRODUCTS IN A VARIETY OF PLEASING FORMS

Milk is not only a nutritious food, but a delicious beverage when served cold, or as "chocolate milk," "malted milk," etc. Butter is in general demand as a tasty spread for bread, and is one of the most concentrated forms of food energy. Cottage cheese makes an excellent substitute for meat and furnishes a superior quality of protein. Ice cream is one of the most popular confections and, although often purchased merely for its refreshing properties, it nevertheless is high in food value.

B. Dairy farming tends to conserve the fertility of the soil.—

Unless some special attempt is made to replenish the elements of plant food taken from the soil in ordinary grain farming, there is a material reduction in plant food with each succeeding harvest. When similar crops are fed to animals and the manure

from them returned to the soil, less plant food is taken from the farm.²

It must be borne in mind, however, that fertility can not be maintained by returning to the soil an amount of manure equivalent to that produced by animals consuming the crops grown on the farm. Even though the manure returned to the soil includes an additional amount secured from purchased feeds, it will not in all cases maintain crop yields.

There is a tendency for many soils, even though heavily manured, to become acid after continued cropping. In such cases it is necessary to add limestone or some similar substance to correct the acidity. It is advisable in any case to increase the supply of lime, which is required in large quantities by our leguminous crops.

Dairying furnishes an added incentive to grow legume crops, for such crops provide a cheap source of protein for dairy cattle and at the same time furnish the principal basis for soil improvement.

C. Dairy cattle yield a high cash return for roughages, pasture, etc.—There are on every farm certain waste feeds, which do not have a direct and ready cash market. Milk or cream, on the other hand, is always in demand and possesses a direct cash value. It is important from the standpoint of the farm income that these waste products be utilized. Since the dairy cow is capable of using such feeds with a higher degree of efficiency than other farm animals, she makes a desirable market for their utilization. Dairy cows are especially valuable in marketing pasture crops. When special pastures, such as sweet clover, are so marketed they yield high acre returns.

D. Dairy cattle furnish a home market for farm crops.—Farm products, especially roughages, are extremely bulky. It is desirable that they be consumed near the source of production and a less bulky product marketed in their stead.

² See Chapter XIX, General Information, for tables showing the elements of plant food in common farm crops and plant food elements in manure and roughages.

Dairy products, particularly cream, are not especially bulky and for this reason offer an advantage in marketing. The establishment of desirable crop rotations, developed with the idea of conserving the fertility of the soil, demands the production of legume crops, which are especially bulky and in many sections not readily marketable. Their conversion into



FIG. 3.—BARN AND DAIRY HERD BELONGING TO A HIGH SCHOOL

This barn was built on the High School grounds at Metropolis, Illinois, to provide means for carrying on a school project in dairying.

milk or butterfat on the farm, therefore, not only furnishes a cash market, but also reduces the marketing problem.

E. Dairying furnishes a market for labor.—Men working in the crafts receive a high hourly or daily wage. Their yearly income, however, is not large because they actually work a relatively small percentage of the year, in many instances only 150 or 200 days. Certain types of farming have tendencies in the same direction in that many of the farming operations are

seasonal in nature. The farmer usually experiences difficulty in finding profitable employment during the remainder of the year. Under such conditions dairying furnishes a profitable market for extra labor. Furthermore, cows require a maximum of attention during the winter months, and a minimum during the summer season when crops make the greatest demands on labor.

Much of the work of caring for cows can be easily and quickly done. The nature of the work is such that the family, especially the older children, can readily assist in its accomplishment. Such work is in no sense harmful unless it involves long hours which would prevent the children from attending school.

F. It provides a continuous cash income.—It is the history of many business enterprises that they ultimately fail for the want of sufficient operating capital. Many farms are less productive and less profitable than they could be made to be if the operator had more capital at his disposal. The dairy business is one which supplies a continuous income and therefore in a sense provides its own operating capital. In this respect the dairyman possesses many of the advantages enjoyed by the man who receives a salary.

2. DISADVANTAGES OF THE INDUSTRY

It is always desirable to consider the disadvantages as well as the advantages of an enterprise. Dairy farming, like most other businesses, has certain inherent characteristics which some people regard as undesirable.

Disadvantages of dairying:

- A. Dairying is confining and requires long working hours.
- B. It is difficult to obtain desirable labor.
- C. Dairy farming involves the investment of considerable capital.
- D. Losses due to tuberculosis and other diseases are high.

A. Dairying is confining and requires long working hours.—In this country cows are milked and fed at least twice each day. This involves responsibility on the part of the dairyman and means that he must himself take care of this work or provide someone to do so. It is further true that milking and feeding are most often done before and after a day's work in the field, which naturally lengthens the working day.

B. It is difficult to obtain desirable labor.—This statement applies particularly to sections where dairying is not common. Often grain farmers are not good milkers and do not desire to work with cattle. Where the herd is large enough to justify employing a man by the year, it is usually possible to secure desirable help. Where dairying predominates, therefore, the securing of labor is not so much of a problem.

Then, too, the milking machine and other labor-saving devices greatly lessen the disagreeable labor that must be performed in caring for cows.

C. Dairy farming involves the investment of considerable capital.—It requires a greater investment in buildings and stock than does grain farming. Where young stock are grown, however, there is an increase rather than a decrease in capital invested in cattle. Considering the nature and amount of returns, therefore, the capital invested is not excessive.

D. Losses due to tuberculosis and other diseases are extremely high.—Losses resulting from tuberculosis are usually due to neglect on the part of those who are in control of the herd. Some herds which have been carefully managed have been kept free of tuberculosis for many years. Occasionally, when a herd becomes badly infected, it is difficult to eliminate the disease and losses are relatively heavy.³ Some other diseases, especially infectious abortion, are difficult to handle and may cause heavy losses.

In general, however, dairying may be regarded as a comparatively safe business, and the hazards to which it is subjected are not greater than those which menace grain farming.

³ A more complete discussion of diseases will be found in Chapter XV.

3. CHARACTERISTICS OF A SUCCESSFUL DAIRYMAN

All men who attain any measure of success in a particular business are in possession of certain characteristics which are basic to success in that industry. Most men who have proved themselves a success in the managing of dairy cattle have certain attributes which are common to good dairymen.



FIG. 4.—HIGH SCHOOL BOYS MILKING COWS IN THE BARN ON THE METROPOLIS SCHOOL GROUNDS

The work of caring for the cows during the school year was carried out by the boys themselves. The various jobs of feeding, grooming, and milking the cows, caring for the milk, cleaning the stable, etc., were rotated at the end of regular periods.

Characteristics of a good dairyman·

- A. Love of cattle.
- B. Willingness to work hard and for long hours.
- C. Capacity for attending to details.
- D. Ability to overcome disappointments.

A. Love of cattle.—Occasionally a man will be successful with livestock without possessing any particular fondness for

animals. But in order to derive a satisfying pleasure out of working with animals, one must have a real love for them. A liking for animals, which will make it a pleasure to go to the barn at night to see if they are comfortable and which will make one's "blood boil" to see an animal abused, is invaluable to the dairyman. If he feels such a love for dairy animals it will go far toward making him successful in his work with them.



FIG. 5.—A HIGH SCHOOL DAIRY

This milk room is in the barn shown in Fig. 3, on the Metropolis school grounds. The boys cooled, bottled, and delivered the milk to customers about town. Empty bottles were collected and washed preparatory to the next milking. The boys also made cash collections from their customers.

D. Willingness to work hard and for long hours.—For one who likes cattle, the work of caring for them is a pleasure, even though it entails difficult tasks, is confining, and involves long hours. Although there is probably no type of farming which requires more personal attention or closer application to busi-

ness than dairying, there is in all probability no other type of farming which yields surer and higher returns.

C. Capacity for attending to details.—It requires a higher type of man to be a good dairyman than to be an equally successful grain farmer. There are many details to attend to and many more specialized jobs to perform than in grain farming.

D. Ability to overcome disappointments.—It is a severe blow to see a valuable animal sicken and die. Unless a dairyman can endure such disappointments he will be dissatisfied with his work. At such times he must be able to recover quickly and recall those cardinal virtues, Faith and Hope.

If he does possess these attributes and puts forth honest effort, he will be able to find his reward in a successful enterprise.

GENERAL INFORMATION

Relation of number of cattle to population.—The food habits of a people are fairly definitely fixed. We can not ordinarily expect a greatly increased consumption of any generally used foodstuff. This is especially true of such staple foods as bread, meat, and milk. To increase the consumption of any one of these three foods would necessarily mean a reduction in the consumption of the other two. One may safely assume, therefore, that the consumption of dairy products will bear an almost direct relation to population.

Table No. II indicates the ratio between population and numbers of dairy cattle from 1850 to 1920 in the continental United States.

From 1870 to 1910 there was very little change in the ratio between the number of dairy cows and the population in the United States. At present there seems to be a tendency for population to increase more rapidly than dairy cattle. This difference, however, is more apparent than real, because the 1920 census made a more rigid distinction between beef and dairy cattle than had been made in previous censuses, with

the result that many animals previously classed as dairy animals were listed as beef animals.

TABLE II
RATIO OF NUMBER OF CATTLE TO POPULATION

Year	Population	Number of Cattle	Persons per Cow
1850	23 191 876	6 385 094	3.63
1860	31 443 321	8 585 735	3.66
1870	38 558 371	8 935 332	4.31
1880	50 155 783	12 443 120	4.03
1890	62 622 250	16 511 950	3.79
1900	75 568 686	17 139 674	4.40
1910	91 972 266	20 625 432	4.45
1920	105 710 620	19 675 297	5.37

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CHAPTER II

SELECTING THE DAIRY COW

A definite relation exists between the form of a cow and her ability to produce milk. To be able to recognize in the individual cow, consistently and accurately, the physical charac-



FIG. 6—TWO HUNDRED CLUB BOYS JUDGING DAIRY CATTLE

The ability to select the most desirable types of dairy cattle is one of the characteristics of the successful breeder.

teristics that go with the ability to produce large quantities of milk, is an almost priceless asset to any dairyman. One can learn to do this only by observing carefully and closely a large number of cows that differ in form, and by studying faithfully the relations between that form and the milk yield of the individual.

Operations:

1. Selecting a cow of the proper size.
2. Naming the parts of the cow.
3. Choosing a cow that will yield heavily.
4. Selecting for strong constitution.
5. Selecting for ample feeding capacity.
6. Selecting for well-developed milking organs.
7. Selecting dairy cows on production records.

1. SELECTING A COW OF THE PROPER SIZE

The larger cows within any dairy breed have been shown to possess the higher productive capacity. The failure of an animal to grow to a good size may be due to either of two causes: (1) lack of sufficient feed to produce normal growth and development; or (2) an unfavorable combination of hereditary factors which the individual has inherited from its ancestors. Calves from stunted cows may be developed by careful feeding into animals of normal size, whereas those of naturally small parents will tend to remain small regardless of the way in which they are fed.

Procedure:

- A. Estimate the weights of five well-grown and five undersized mature cows.
- B. Measure their height and length of body.
- C. Study your herd or that of a neighbor from the standpoint of the size of the animals.
- D. Determine the average size of mature cows of the different dairy breeds in your community.

A. Estimate the weights of five well-grown and five undersized mature cows.—Select five cows that are well-grown for their breeds and five that are small. Choose, if possible, cows that are of similar breeding and in approximately the same condition of flesh. Estimate the weights of these cows and then

check your estimates with the actual weights of the animals over the scales. If scales are not available, ask a number of farmers or experienced cattle buyers to estimate the weights and take the average of their estimates as the check upon your own. Note the variation between your estimate and the actual weight or average estimate for each cow. Attempt to determine why your estimates were not in agreement with the



FIG. 7.—A JUDGING DEMONSTRATION

A calf club member pointing out the milk wells on his Jersey heifer to his club leader.

actual weights. Profit by this procedure when you again estimate the weight of an animal.

B. Measure their height and length of body.—When two animals of the same height and length of body differ in weight, the difference may be due to either of two factors: (1) difference in general form, or (2) difference in condition of flesh. If the cows that you have selected are gentle, measure their

heights at the wither. If they are not gentle, measure the height of other cows of different sizes and forms.

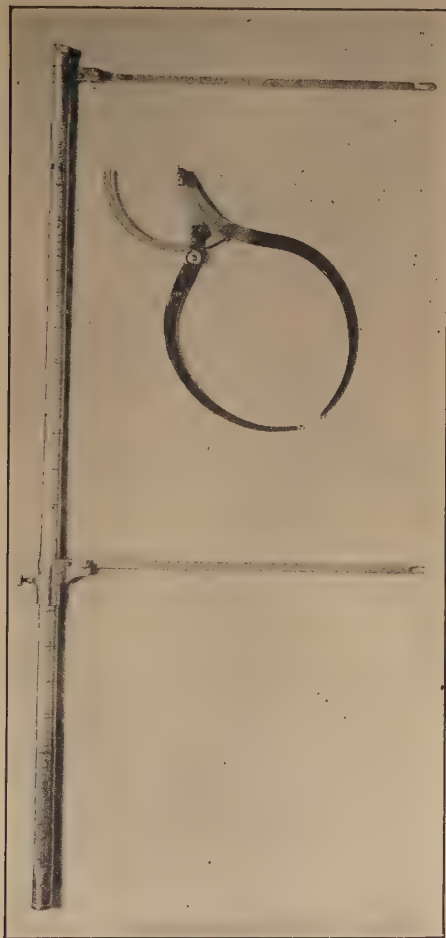


FIG. 8.—MEASURING STANDARD AND CALIPER

These instruments are useful in measuring dairy animals quickly and accurately.

In measuring the height at the wither, be sure that the animal is standing squarely on its feet and is in a normal posi-

tion. Use a standard¹ graduated in centimeters or inches, preferably one with an adjustable arm at right angles to the main standard. Place the standard on the ground and perpendicular to it. (Some standards are equipped with a spirit level to aid in keeping the instrument exactly perpendicular.) Lower the adjustable bar until it touches the highest point of the wither of the animal to be measured, and take your readings for height from the under side of the bar on the graduated scale of the standard.

Obtain the length of body by measuring the horizontal distance between shoulder points and pin bones.

TABLE III
NORMAL SIZE OF DAIRY FEMALES *

Age	Holsteins		Ayrshires		Jerseys	
	Weight, pounds	Height, inches	Weight, pounds	Height, inches	Weight, pounds	Height, inches
At birth.....	90	28.3	69	.....	55	26.0
1 month.....	121	30.2	90	27.5	76	27.7
2 months.....	157	32.3	128	29.5	105	29.4
3 months.....	200	34.2	170	31.2	140	31.2
4 months.....	249	36.2	218	33.1	174	32.9
5 months.....	302	38.0	254	35.1	222	35.1
6 months.....	349	39.7	286	36.4	260	36.9
9 months.....	466	42.9	366	39.0	376	40.5
12 months.....	588	44.8	456	40.7	456	42.6
15 months.....	612	46.8	547	42.4	520	44.4
18 months.....	686	47.9	604	43.7	572	45.5
24 months.....	841	49.8	759	45.9	716	47.4
30 months.....	1021	51.5	.....	47.2	764	48.3
36 months.....	962	52.3	.....	47.9	.....	48.9
48 months.....	1065	53.1	917	48.5	854	49.4
60 months.....	1140	53.6	960	49.1		
72 months.....	1220	54.0	1022	.....	897	

* Adapted from Brody and Ragsdale, Mo. Agr. Exp. Sta., Res. Bul. 62, 1923.

¹ A splendid set of measuring instruments can be obtained through Eimer & Amend, Third Ave. and 18th St., New York City. This set includes a caliper and standard similar to those illustrated in Fig. 8.

C. Study your herd or that of a neighbor from the standpoint of size of animals.—Make a comparison between the size of animals in your herd and those of your neighbor. Unless you are interested in some special herd, choose one near by for this study. Are the animals, age considered, larger or smaller than those of other herds? Are they in the same condition of flesh? Does it appear that the difference, if any, is due to feeding or to the hereditary characteristics of the animals?

D. Determine the average size of mature cows of the different dairy breeds in your community.—Determine the average size of mature cows of all the different breeds in your locality, using the weights and measurements already obtained and making similar studies of the different breeds in your vicinity. Check your findings with the values in Table III. Are your animals larger or smaller than those given for the breeds which you have studied?

2. NAMING THE PARTS OF THE COW

In order to draw accurate comparisons or make contrasts between cows, or even to describe the characteristics of an individual animal, one must discuss the cow part by part. At the very outset, therefore, it is necessary for you to familiarize yourself with the names of these parts. Study Chart II and be able to locate all of the parts shown as well as the more common ones which you should already know.

Procedure:

- A. Name and locate all the parts of the head and neck.
- B. Name the parts of the body.
- C. Name and locate the parts of the milking organs.

A. Name and locate all the parts of the head and neck.—Locate the muzzle, which is the part above the nostrils and around the lower portion of the face. Identify the poll, the

dish in the face, the position of the horns. Observe the relation of the length to the width of the head. Note the length of neck and whether or not the throat is clean-cut.

B. Name the parts of the body.—First study the topline and learn to know the difference between the back, loin, and rump regions. Observe the heart girth, or the distance around the

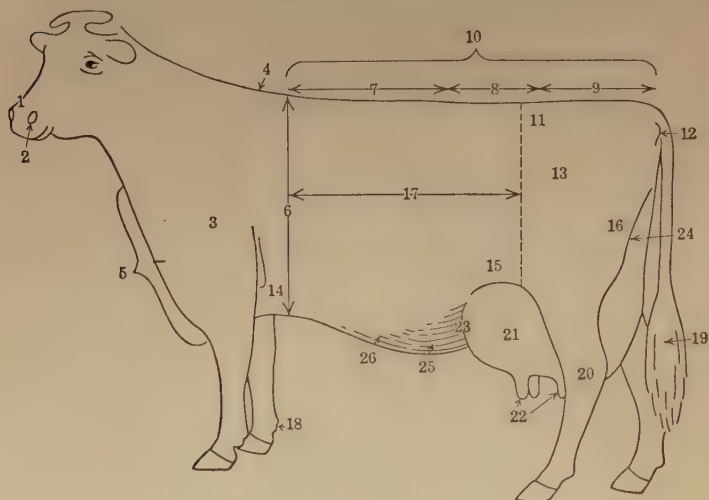


CHART 2.—PARTS OF A DAIRY COW

1. Muzzle; 2. Nostril; 3. Shoulder; 4. Withers; 5. Dewlap; 6. Heart girth; 7. Back; 8. Loin; 9. Rump; 10. Topline; 11. Hooks; 12. Pin bones; 13. Thurl; 14. Elbow; 15. Rear flank; 16. Thigh; 17. Barrel; 18. Dew claws; 19. Switch; 20. Hock; 21. Udder; 22. Teats; 23. Front attachment of udder; 24. Rear attachment of udder; 25. Milk vein; 26. Milk well.

body just back of the shoulders. Note on the chart how much deeper the barrel is in the rear portion than in the front. See if this is true in the animals you study. Note the position of the hocks and pin bones. Observe whether or not the animal stands straight on its hind legs, as does the cow on the chart, or whether there is a greater bend at the hock (sickle-hocked). Are the hind legs together at the hocks with feet apart (cow-hocked), or are the legs straight?

C. Name and locate the parts of the milking organs.—

Observe carefully the udder as it appears on the chart. Compare its size with the size of the entire cow. Make a similar comparison in cows that you study. As you have opportunity to inspect cows, observe the forward and rear attachments of the udder and note the size and location of the teats and the position of the milk veins. Find the milk well by feeling with your index finger at the end of the milk vein.

Characteristics of the good milk cow.—The ability to secrete milk is one of the principal characteristics common to mammals. Other characteristics of this order of animals are that they possess hair and bring forth their young alive. The lowest group classed as mammals, the monotremes (wombat and spiny ant-eater), lay eggs, and nourish their young by the secretion of milk from small rudimentary glands located at the roots of hairs. The young obtain this milk-like material by licking these hairs. The next higher group is the marsupials, or pouch-bearing forms, of which the kangaroo and opossum are the most common illustrations. The young of the marsupials are born in a very immature state, are put into a pouch by the mother, and derive their nourishment by adhering to rudimentary mammae or teats. From these lower forms we find progressive development until in the cow we have probably the most pronounced and prolonged ability to secrete milk found in any of the mammals.

3. CHOOSING A COW THAT WILL YIELD HEAVILY

The function of milk production is so highly developed in the dairy cow that she will sacrifice the tissues of her own body to produce milk. It has been observed many times that cows will use up as much as one-sixth to one-fifth of their own weight (if in good condition when milk secretion begins) for the production of milk. This pronounced disposition to secrete milk is termed dairy tendency. All cows do not possess it to the same degree. It is highly important, therefore, to be able to distinguish

between cows that are good in this respect and those that are lacking.

Procedure:

- A. Choose a cow with a clean-cut face and long, slender neck.
- B. Choose a cow with prominent, clear, bright eyes.
- C. Choose a cow that is open in conformation.
- D. Choose a cow that does not carry excess flesh when milking.
- E. Choose a cow with loose, mellow hide.

A. Choose a cow with a clean-cut face and long, slender neck.—One of the best evidences of dairy tendency is a lean face and head with clean-cut features. The face in most breeds, especially the Jersey, should show a pronounced dish between the eyes. The jaws should be strong and free from excess flesh. The neck should be long and slender and free from an undue amount of dewlap.

B. Choose a cow with prominent, clear, bright eyes.—Select a cow with large, prominent eyes without too much white about the pupil. The look from the eye should be alert. Be sure, however, that it is mild and does not show a wild or restless disposition. Dull, half-closed eyes are a sign of sluggishness.

C. Choose a cow that is open in conformation.—Openness of form, as it is called, is characteristic of a dairy animal, in direct contrast with the compact, low set, and thickly fleshed character of the beef animal. For milk production, select the cow with open shoulder. To determine this, insert the hand between the shoulder and neck of the cow. Avoid winged, or widely spreading, shoulders as they indicate a weakness at this point. The backbone should also be prominent, the processes, or prominences, easily distinguishable and the depressions clearly evident. The ribs should be wide apart, and the distance between the last rib and the hook quite long. The ribs

should also be wide, as wide ribs together with a good distance between them means a long-bodied cow, which is desirable.

D. Choose a cow that does not carry excess flesh when milking.—In picking your dairy cows, pay special attention to the length of time they have been milking. Cows that have calved somewhat recently, that is, from one to eight months,



FIG. 9.—SOCIABLE SYBIL

A large, rugged cow, excellent in type and seventeen times a Grand Champion. Yearly record of 15,334 lbs. milk and 855 lbs. fat. A splendid combination of Jersey type and productive ability.

should not be carrying much fat unless they are under very heavy feeding for large records. Cows that do carry excess flesh when milking are usually deficient in dairy tendency and are neither heavy nor persistent milkers.

There is a different feel to the touch of flesh that is temporarily stored by the good dairy cow, to be drawn on during her milking period, and the touch of tissue habitually carried by a cow. The former tissue is soft and spongy and smoothly

laid on, whereas the latter is harder and is usually put on in patches, especially about the tail head.

E. Choose a cow with loose, mellow hide.—Notice that the hide of a good dairy cow in a healthy working condition is loose and mellow. With the thumb and fingers pick up the skin of a dairy cow just over the last ribs. Draw it gently from the body. Observe how loose and pliable it is. Do the same with a beef animal and note the coarser, heavier hide. The quality of an animal is also noticeable in its hair, the hair of the dairy cow in good condition being soft and neither wiry nor coarse.

4. SELECTING FOR STRONG CONSTITUTION

A dairy cow in full flow of milk does more work in converting the energy of feed into the energy of milk, in digestion, and in other body processes than the draft horse ordinarily does in the same length of time. The conversion of large quantities of feed into milk, if continued year after year, makes unusual demands upon the constitution of the cow. It is, therefore, highly important to select a cow that is vigorous and gives evidence of possessing a strong constitution.

Procedure:

- A. Determine depth and breadth of chest.
- B. Note whether cow has strong head.
- C. See that cow has large, open nostrils.
- D. Make sure that ribs are well sprung.

A. Determine depth and breadth of chest.—Stand in front of the animal you are observing and note whether or not she has a broad, full chest with a good width between the front legs. Observe also whether or not the chest is full and well rounded out at the elbows. Look down over the shoulders of the animal and determine the width of the chest and the spring of the upper rib.

B. Note whether cow has strong head.—The head of a cow not only is indicative of the quality and dairy tendency of the animal but also bears a relation to her vigor and strength. A face that is strong and broad, especially below the eyes and above the muzzle, is to be desired. Also look for a good depth of jaw and a fairly good width between the jaws.



FIG. 10.—WISCONSIN FOBES 6TH

A splendid example of Holstein type, showing a deep, capacious body and large, well-developed udder. Cows of this type are in great demand.

C. See that cow has large open nostrils.—Cows that possess small muzzles, narrow faces, and small nostrils frequently are lacking in constitution and because of that fact do not produce a large quantity of milk. One should select cows that have large, full muzzles and open, flowing nostrils.

D. Make sure that ribs are well sprung.—It is not to be expected that the dairy cow will show the extreme spring of rib displayed by the beef animal with its broad, flat back. However, the ribs should start from the spinal column almost at right angles to it, rather than begin to droop off abruptly,

making a narrow animal. Cows with well-sprung ribs, even though they are not so deep in body, usually are more vigorous and many times are more persistent in production than narrow animals.

5. SELECTING FOR AMPLE FEEDING CAPACITY

The dairy cow in heavy flow of milk must consume a large quantity of feed. Furthermore, if she is to produce profitably it is necessary that much of this feed be in the form of extremely bulky roughages. Nature has endowed the cow with a digestive system adapted for the use of this rough feed. All cows, however, are not equally well fitted by nature for this purpose. The good dairyman is able to tell by the development of certain portions of the cow's body how well she will take care of large quantities of feed.

Following are the points that should be looked for in selecting a cow with a large feeding capacity:

Procedure:

- A. Select for a strong muzzle.
- B. Choose cows with long, broad bodies.
- C. Reject cows that are especially deficient in depth of body.
- D. Look for greedy eaters.

A. Select for a strong muzzle.—A strong muzzle with full lips shows that the cow is able to consume a large amount of feed.

B. Choose cows with long, broad bodies.—Cows are usually longer in body in proportion to their height than bulls. They are also required, because of milk production, to consume a larger amount of feed for a given weight of animal. Observe cows in your herd or vicinity and determine whether or not the long-bodied cows with well-sprung ribs are regarded as the larger eaters.

C. Reject cows that are especially deficient in depth of body.

—A shallow body usually means that a cow does not have a good constitution and is not able to consume any great amount of feed. In considering this characteristic, however, one should find out how the animal has been fed. Animals which have not received enough feed or those which have been sick may look extremely deficient in depth of body and yet, when in normal condition, may be quite acceptable in that respect. Compare the animal in question with others in the herd. If all are in like condition, the trouble is probably due to lack of feed.

D. Look for greedy eaters.—A good appetite is an asset to a dairy cow. Watch several cows while they are eating and note the differences in the way in which they consume their feed. Observe cows at pasture and study their methods of eating. Count the number of bites which several of them take per minute.

6. SELECTING FOR WELL-DEVELOPED MILKING ORGANS

Milk is secreted in the mammary gland, or udder. It is in this organ that the food materials which the cow eats, after having been digested and assimilated in the blood, are converted into milk. Perhaps no single part of the cow is so important in determining her milk-producing ability or her sale value as the udder. Because of this fact, much of the time used in selecting a cow should be spent in carefully examining the udder.

Procedure:

- A. Choose a cow with medium-sized, well-balanced udder.
- B. See that the udder is held snugly to the body.
- C. Select an udder that is properly shaped.
- D. Examine the udder for texture or quality.
- E. Observe whether teats are well placed and of proper size.

- F. Examine teats for warts, extra openings, or leakage.
- G. Notice development of milk veins and wells.

A. Choose a cow with medium-sized, well-balanced udder.—

The size of a cow's udder is somewhat of a measure of the amount of milk which she is producing. If the volume of an udder is determined before milking and again after milking, the difference is approximately equivalent to the amount of milk removed. In the examination of an udder, it is important to know when the animal was last milked, and how much of the size is due to the milk contained and how much to the tissues of the gland itself. Age is also a factor in the development of an udder. Young cows cannot be expected to show the development in this organ found in older animals.

Too large an udder is objectionable, because of the danger of injury. Over-development usually indicates that the gland is not functioning normally. You should be able to distinguish between the extreme distention of the udder due to the feverish and swollen condition just before and shortly after calving and the naturally large gland referred to above. Too small an udder indicates a lack of capacity. Before condemning a cow on this basis, however, it is well to take into consideration the age of the animal and the length of time from calving.

The examination of a large number of cows shows that from 55 to 65 per cent of the yield of milk is the product of the two rear quarters. From 35 to 45 per cent is produced by the front quarters. Many individual animals show even wider differences than these. A desirable udder is one in which not more than 60 per cent of the milk comes from the rear quarters or less than 40 per cent from the front quarters. A greater difference than this usually means that there is an improper balance, or unevenness in development of the quarters, with the front quarters objectionably deficient.

B. See that the udder is held snugly to the body.—It is important that the udder be attached high and wide at the rear. When it is so attached there seems to be less tendency

for the tissues to relax and permit the udder to break away from the body. Furthermore, an udder with a wide rear attachment is usually wider than one with narrow attachment and so has good capacity without extreme depth. The front attachment of the udder should be well forward and somewhat wider than the rear attachment. There should be no tendency for a separation between the udder and the body of the animal. The tendency for an udder to "break away" from the body becomes more pronounced with each succeeding lactation.



FIG. 11.—AN EXTREME TYPE OF PENDULOUS UDDER

This udder is so badly broken away from the body that it is almost useless. Note the chafed condition of the lower portion, and the teats, which appear little more than warts.

Figure 11 pictures an extremely pendulous udder, one so pendulous that it is much in danger of injury. Such a condition reduces the productivity as well as the sale value of an animal.

C. Select an udder that is properly shaped.—Animals with well-shaped udders are in demand. Figure 12 shows a Jersey cow with an ideally shaped udder. Notice the high rear attachment and the equally balanced rear quarters. Observe also the well-developed front quarters and the snugness with which

the udder is held to the body, even though the udder is "bagged"² to its full capacity. Figure 13 also pictures a desirable type of udder. This udder is not distended by bagging but is of normal working size. Figure 14 illustrates an udder deficient in front quarters and lacking proper balance. Another deficiency not uncommonly found is badly divided quarters. This is especially common in the front quarters. Figure 15 gives an idea of such an udder.



FIG. 12.—UDDER APPROACHING THE IDEAL FORM

The rear and forward attachments of this udder are excellent. The quarters are evenly developed and the teats are especially well placed.

D. Examine the udder for texture and quality.—The udder is composed of different kinds of tissue, two of which, the secreting tissue and the supporting or connective tissue, predominate. The secreting tissue, as the name indicates, actually secretes the milk. The supporting tissue binds the secreting tissue together and holds it in position. Secreting tissue is soft, flexible, and spongy to the touch, whereas supporting tissue is hard and flesh-like.

² "Bagging" a cow is permitting milk to accumulate in the udder until there is so much distention that every portion of the gland is gorged with milk.



FIG. 13.—THE USEFUL AND DESIRABLE TYPE OF UDDER

Note the symmetry and balance as well as the splendid forward attachment of this udder. Good-type cows with udders of this kind are always in demand.



FIG. 14.—AVOID POORLY DEVELOPED FORE UDDERS

Some cows have a tendency toward light front quarters. Occasionally fore udders of this kind can be brought to normal production by rubbing and manipulating them just prior to calving.

It is highly desirable that the udder be of good texture or, in other words, contain a high percentage of secreting tissue. Such an udder is capable of producing more milk per given unit of tissue than one that possesses a higher proportion of connective tissue. It is almost impossible to judge of the texture when an udder is highly distended with milk. When this is the case, it will be necessary to remove the milk and examine the empty udder. An udder that collapses when milked out and is loose and pliable when handled is ordinarily one of good



FIG. 15.—AN UNDESIRABLE TYPE OF UDDER

Observe the deep cleft between the two front quarters and the tendency of the udder to break away from the body. Udders of this type are undesirable and subject to injury and reduce the selling price of the animal.

texture. Udders that are hard and “meaty” to the touch are often associated with a lack of persistency in the cow.

F. Observe whether teats are well placed and of proper size.—The teats are best located at least 6 inches apart from front to rear and almost an equal distance from side to side. Teats that are too close together interfere with the operation of milking. Teats should be large enough to be grasped readily by the hand and yet not so large as to make milking difficult or tiresome for the milker. Teats that are too small make milking somewhat difficult and slow.

F. Examine teats for warts, extra openings, or leakage.—The teat should be smooth and free from warts. In case warts are present, they can sometimes be reduced and softened by the application of vaseline or some similar substance. Occasionally there is an extra opening in the side of a teat. Such an opening is undesirable as it tends to soil the milker's hands and to cause a loss of milk. Not infrequently a cow is found in which the



FIG. 16.—BREEDERS ARE ALWAYS PLEASED WITH UDDERS OF THIS TYPE

Note the high, wide rear attachment of this udder as well as the splendid milk-vein development.

sphincter muscle ordinarily closing the opening of the teat does not function normally. The result is that the milk drips, or at times may even run in small streams, from one or more teats. Such a condition is undesirable even though cows so affected are usually easy milkers. Again, it is not uncommon to find cows in which one or more teats spray milk at the time of milking. Such a condition not only is insanitary and causes

a loss of milk but also is likely to soil the clothing of the milker.

G. Notice development of milk veins and wells.—Perhaps no two terms are more frequently misunderstood than “milk vein” and “milk well.” The name “milk vein” would seem to indicate that the vein contained and carried milk, but such is not the case. The milk vein carries blood from the udder



FIG. 17.—LARGE AND TORTUOUS MILK VEINS

Large milk veins and wells are an indication of high milk yield. In this cow the location of the well is indicated by the pencil.

toward the heart, for purification, and thus performs the same function as other veins, all of which carry blood. Two milk veins are located on either side of the animal, extending along the underline and lying just beneath the skin. The openings through which these veins enter the body cavity are termed milk wells. Generally there are but two openings, or wells, one on either side. Not infrequently the milk vein separates into a number of branches, each one of which enters the body

cavity through a separate opening. Cases are reported in which as many as thirteen openings, or milk wells, have been observed in a single animal. Figure 16 shows an extreme development of rear udder and milk veins. Figure 17 also illustrates large, tortuous veins.

Large milk veins and milk wells are associated with high milk yield. It must be borne in mind, however, that extreme development usually appears in older animals. Large milk



FIG. 18.—GOOD AND POOR COWS

These cows were kept in the same herd under the same conditions. Cow B produced 2.1 times as much butter fat as A, yet good judges almost invariably chose A as the better producer.

veins and wells are more an evidence that cows have produced heavily in the past than that they will produce heavily in the future.

7. SELECTING DAIRY COWS ON PRODUCTION RECORDS

It is an old adage that "The proof of the pudding is in the eating of it." It is no less true that the proof of the productive ability of the dairy cow is her actual yield of milk and the amount of butterfat which it contains. Whenever it is possible to select cows on authentic production records, this method is far

superior to making a choice on the basis of physical characteristics. Figure 18 shows two cows owned by the same dairyman, kept in the same herd, fed the same feed, cared for by the same man, and tested in the same cow-testing association. Under these conditions Cow A produced 197 pounds and Cow B 413 pounds fat in one year; yet dairymen selecting them on the basis of physical characteristics, without any knowledge of their records selected A more frequently than B as the better producer. This is an unusual condition but illustrates the superiority of actual records as a basis of selection. Chapter IV describes in detail the method employed in obtaining production records and points out some of the advantages to be obtained by their use.

GENERAL INFORMATION

Yield of Milk per Cow in Various Countries.—To those who are interested in herd improvement, it is a matter of deep concern that the United States appears so low in the list in Table IV, showing the comparative yields of milk per cow in various

TABLE IV
AVERAGE ANNUAL YIELD OF MILK PER COW IN VARIOUS COUNTRIES

Country	Year	Average Yield of Milk in Pounds
Netherlands.....	1902	7585
Switzerland.....	1914	6950
United Kingdom.....	1914	5934
Denmark.....	1914	5666
Germany.....	1912	4350
Canada.....	1911	3779
Norway.....	1910	3680
<i>United States</i>	<i>1920</i>	<i>3627</i>
Sweden.....	1911	3600
Japan.....	1918	3339
Australia.....	1916	2719

countries. This cloud develops a silver lining, however, when one realizes how much opportunity there is for improvement and that it is much easier to increase low than high production. It is only fair to the dairy industry in this country, and particularly to the regions marketing whole milk, to state that the average production of the cows in these regions compares more favorably with the averages of other countries.

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CHAPTER III

CHOOSING A BREED

One of the questions most frequently asked by the prospective dairyman is, "What is the best breed of dairy cattle?" Such a question can not be intelligently answered until all of the facts regarding the market, the climatic conditions, system of management, and local surroundings are available. Even then it must be understood that inferior animals of one breed can not compete on equal terms with superior animals of another, even though the latter breed is not so well endowed by nature for the conditions and market in question. A discussion is here given of the various factors that should be considered before selecting a breed.

Factors determining choice:

1. Community preference.
2. Adaptation to climate and environment.
3. Adaptation to market.
4. Personal preference.

1. COMMUNITY PREFERENCE

Many advantages may be had by choosing the breed of cattle that predominates in the community, unless there be a definite reason for doing otherwise.

Procedure:

- A. Determine which breed predominates in the community.

- B. Determine whether or not breeders are satisfied with their cattle.
- C. Find length of time breeds have been kept.
- D. Determine breed kept by most progressive dairymen.

A. Determine which breed predominates in the community.

—Make a survey of the farms in your community or township in order to determine the breed of dairy cattle most commonly



FIG. 19.—KING HOMESTEAD DE KOL

A Holstein bull with great length and depth of body. Grand Champion, National Dairy Show, 1911.

found. List animals under the following headings: Holstein; Jersey; Guernsey; Ayrshire; Milking Shorthorn; and Native Stock. The last-named class should include all animals that apparently do not belong to any of the other groups. In the case of mixed herds, list animals separately by breeds. When animals are pure-bred and registered, so indicate by the initials P. B.

B. Determine whether or not breeders are satisfied with their cattle.—In making your survey, learn, if possible, whether or not the breeders are satisfied with the production and characteristics of their cattle. Make a list of the criticisms, both favorable and unfavorable, that you obtain. Ask the dairymen what breed of cattle they would choose if they were again starting in the business.



FIG. 20.—FERN'S WEXFORD NOBLE

Considered one of the best-type bulls of the Jersey breed. Large in size and impressive in appearance, he represents one of the most perfect specimens the breeder's art has been able to produce. Grand Champion, National Dairy Show, 1922-23-24.

C. Find length of time breeds have been kept.—Find out, if possible, the approximate date of the establishment of the different breeds in your community. Discuss with the older dairymen the order in which different breeds were introduced and the reasons for their introduction.

D. Determine breed kept by most progressive dairymen.—One of the best guides in agriculture is afforded by the prac-

tices of the most progressive and successful farmers in the community. It is good judgment, therefore, to consider carefully the breeds selected by the most successful dairymen and their methods in handling them.

2. ADAPTATION TO CLIMATE AND ENVIRONMENT

Extremely cold and extremely hot climates are alike unfavorable for the production of milk, unless some special provision is made to keep the cows more comfortable than they normally would be. The breeds react differently to extremes in climate. It is therefore important to know climatic conditions before choosing a breed.

Other factors in selecting a breed are the kind of care and the housing you will be able to give your cattle. Some breeds are larger and more vigorous than others. Their calves are stronger and less subject to disease, or have more resistance when disease is contracted, than the calves of other breeds. Such breeds are able to develop under conditions which would be unfavorable for other breeds.

Procedure:

- A. Find mean temperature for winter and summer.
- B. Determine annual rainfall and abundance of feed and pasture.
- C. Consider the sort of care the herd can be given.

A. Find mean temperature for winter and summer.—Consult weather reports and records for your locality or for some city near by. If you live in the southern states you will find the summers more or less unfavorable to the larger breeds, notably Holsteins. On the other hand, if you are located in the northern states you will find the larger breeds seem to thrive best. Where the climate is not extreme, little attention need be given this factor.

B. Determine annual rainfall and abundance of feed and pasture.—While looking up the temperature records, learn

also the annual rainfall and the period of the year when the moisture is greatest. While the influence of rainfall on dairying

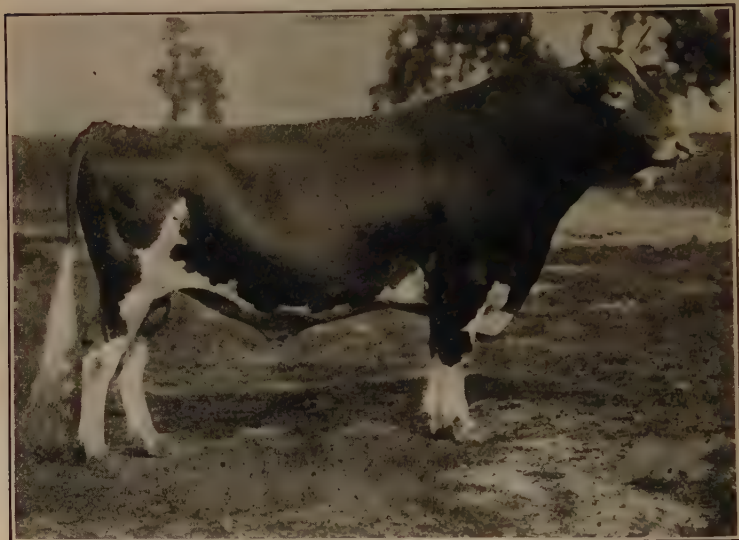


FIG. 21.—SHOREWOOD RESOLUTE

A Guernsey bull, large in size but showing quality and refinement. Grand Champion, National Dairy Show, 1924.

is indirect, it is important in that it affects pastures and crops, especially hays, on which the industry is dependent. Where roughages are plentiful, the larger breeds, as Holstein and Brown Swiss, thrive especially well and so are greatly favored. Where there is a deficiency of these feeds, the smaller breeds, as Jersey and Guernsey, are more generally found.

C. Consider the sort of care the herd can be given.—Some breeds of cattle, as Ayrshire and Brown Swiss, seem to be able to withstand poor shelter and lack of care better than others. Furthermore, the calves of some breeds are larger and seemingly more vigorous than those of other breeds. Generally speaking, the larger the calves are at birth the more resistant they are to disease and unfavorable conditions. Table V shows the average birth weights of calves of the different breeds

of dairy cattle as well as the ratio of that weight to the weight of the mother.



FIG. 22.—IMP. MILDRED 2D OF LES GODAINES

A Guernsey cow combining desirable type and productive capacity. Record, 14,890.9 lbs. milk, 702.24 lbs. fat. Grand Champion, National Dairy Show, 1920.

TABLE V
BIRTH WEIGHTS OF CALVES OF THE DAIRY BREEDS.*

Breed	Number of Calves	Average Weight, pounds	Average Weight of Dams, pounds	Per Cent of Dam's Weight
Jersey.....	253	55	867	6.35
Holstein.....	229	89	1137	7.83
Guernsey.....	57	71	996	7.03
Ayrshires.....	80	72	983	6.41
Brown Swiss.....	5	100	1123	8.90

*From Eckles, C. H., Mo. Agr. Exp. Sta., Res. Bul. 35, 1919.

If you are intending to care for the dairy herd yourself or to give it your personal supervision, very little attention need be paid to the ability of a breed to withstand poor care. If you are entrusting the herd to indifferent employees, give these facts some consideration.

3. ADAPTATION TO MARKET

Perhaps no single factor is so important in deciding whether this breed or that shall be chosen as the local market for dairy



FIG. 23.—IMP. HOWIE'S KING OF HEARTS

One of the aristocrats of the show ring. Grand Champion, National Dairy Show, 1922. An Ayrshire bull of substance, quality, and refinement.

products. Where a given type of market prevails, the breed best adapted to the demands of that market is usually found. This ordinarily means that the breeds tend to be segregated, one breed being especially numerous where whole milk is produced and sold, and another where there is a market for cream. In

selecting a breed, therefore, a study should be made of the available markets in the community and of the breeds that are best adapted to supply those markets.

Procedure:

- A. Find whether or not whole milk is sold, and if so for what purpose.
- B. Determine if cream is the principal product marketed.



FIG. 24.—BARBOIGH PRIMROSE 2D

A matron of desirable Ayrshire type. Observe the clean-cut head and long, slender neck. Note that the color is in splashes rather than in distinct spots as in the Holstein and Guernsey breeds.

- C. Determine whether or not hogs are extensively and profitably grown.
- D. Investigate special markets.

A. Find whether or not whole milk is sold, and if so for what purpose.—In sections near our larger cities, almost all

the milk produced is marketed in the form of whole milk. The same is more or less true in the vicinity of cheese factories or condenseries. Where such markets prevail, the higher-yielding breeds predominate, particularly the Holstein. In these regions the farm operations are centered around dairying, the enterprise that brings in the largest part of the farm income.

B. Determine if cream is the principal product marketed.—In sections somewhat removed from our larger cities, and from



FIG. 25.—MY ONE BOY

A Brown Swiss bull of unusual type and refinement. Grand Champion, National Dairy Show, 1913.

cheese factories or condenseries, cream or butterfat production is the main dairy enterprise. In such regions the herds are usually small, dairying being only a side line, subordinate to other farm operations and bringing in only a minor part of the farm receipts. Cows giving milk containing a high percentage of fat are usually favored in these sections where cream is marketed. Except in certain northern states, Jerseys predominate for this type of market.

C. Determine whether or not hogs are extensively and profitably grown.—When butterfat is marketed, skim milk remains as a by-product on the farm. Its principal use lies in livestock feeding, particularly for calves, hogs, and poultry. While part of it is generally used for calf feeding, the largest portion is usually available for hog or poultry feeding. One hundred pounds of skim milk for hog feeding purposes is con-



FIG. 26.—ARLENE

Observe the shapely udder and generally good type. Grand Champion Brown Swiss cow, National Dairy Show, 1914.

sidered equivalent in value to one-half bushel of corn. When corn sells at one dollar per bushel, skim milk is considered worth 50 cents per hundred pounds. In feeding for special purposes, such as fitting hogs for show or exhibition, skim milk has a still higher value. Where there is this profitable use for skim milk, the higher-yielding breeds may be favored rather than the breeds giving the highest yield in butterfat.

D. Investigate special markets.—Occasionally there are opportunities to supply a product to a special or select market. For instance, a demand may be created for the retail sale of a special milk for babies or for unusually rich milk. It is sometimes possible to sell sweet cream for ice cream or for some other special purpose.

TABLE VI
LIVE WEIGHT AND PRODUCTION OF COWS OF THE DAIRY BREEDS.

Breed	Average Live Weight Pounds	Average Yearly Milk Yield, Pounds	Average Per Cent Fat in Milk, Per Cent	Source of Data
Holstein.....	.....	7,218	3.54	2773 cow-testing association records.*
Holstein.....	.....	14,887	3.41	5266 advanced register records.*
Holstein.....	1225	14,712	3.43	148 Wis. cow competition records.†
Jersey.....	.....	5,364	5.14	970 cow-testing association records.*
Jersey.....	.....	8,005	5.41	8038 Register of Merit records.*
Jersey.....	909	7,063	5.15	76 Wis. cow competition records.†
Guernsey.....	.....	8,644	5.03	3564 advanced register records.*
Guernsey.....	987	8,549	4.98	141 Wis. cow competition records.†
Ayrshire.....	.....	9,417	3.93	1091 advanced register records.*
Ayrshire.....	1031	6,070	3.99	9 cows, 24 lactations, University of Illinois herd.
Brown Swiss..	.....	11,281	4.00	311 Register of Production records.*
Brown Swiss..	1100-1200			

* Ill. Agr. Exp. Sta., Bul. 245.

† Wis. Agr. Exp. Sta., Res. Bul. 26.

Determine which of the dairymen in your locality market their milk or cream in some special way. Compare the prices which they receive with those prevailing in the general market. Study the advantages and disadvantages of marketing in this way and conclude whether or not all breeds of dairy cattle are equally well suited to production for that market.

4. PERSONAL PREFERENCE

Some dairymen dislike the appearance of a Holstein but develop a great fondness for a Jersey. Others admire the ruggedness and large frame of the Holstein but have a great aversion to the smaller and more refined Jersey. Tastes differ in cattle as they do in clothes, and as the possession of a particular breed may mean much to the pleasure of the owner, he should give consideration to the breed of his fancy. It must be remembered, however, that in the long run beauty will not wear so well as utility.

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CHAPTER IV

DETERMINING MILK AND BUTTERFAT YIELDS

The keeping of milk and butterfat records is an essential part of a program of herd improvement. It is only by knowing how much each cow produces that the dairyman can select the best cows for building up the herd. In many cases an increase in the level of production and financial returns from the herd can not be brought about successfully until the individual milk and butterfat yields have been determined.

There are several different ways in which such records may be secured. The routine work may be performed by the owner or caretaker; or the owner may become a member of a cooperative cow-testing association, or herd improvement association, as it is sometimes termed, and thus secure the services of a paid tester. The owner of purebred dairy cattle may arrange to have records of production made by the breed association in charge of the registration of his cattle. Records of the latter sort are termed "Advanced Registry" or "Register of Merit" records. The procedure to be followed in obtaining records in these different ways is outlined below.

Operations:

1. Keeping milk-production records.
2. Sampling milk for butterfat tests.
3. Testing milk for butterfat.
4. Calculating butterfat yields.
5. Determining milk and butterfat yields through the agency of a cow testing association.
6. Making Advanced Registry or Register of Merit records.

1. KEEPING MILK-PRODUCTION RECORDS

The total monthly or yearly production of each cow may be calculated and recorded with the aid of the simple equipment described below.

Procedure:

- A. Provide milk-record blanks.
- B. Secure scale for weighing milk.
- C. Arrange convenient place for weighing.
- D. Weigh milk from each cow regularly.
- E. Compute milk production for month and year.

Equipment:

Record blanks, scale, thumb tacks, glass case or sheets of celluloid, bracket or wire.

A. Provide milk-record blanks.—Secure a supply of these blanks from a firm offering them for sale, or rule some sheets of heavy paper about 12 by 24 inches in size, like the form shown in Fig. 27. A sheet with spaces for recording two milkings daily for one month is convenient for most herds, but forms may also be purchased for recording three or four milkings daily.

B. Secure scale for weighing milk.—Purchase a small scale having a capacity of 30–60 pounds, such as the one shown in Fig. 28. A scale having two adjustable hands is especially desirable for weighing milk. By setting one hand at zero when the empty pail is hung on the scale, the weight of the milk may be read directly when the filled pail is weighed.

C. Arrange convenient place for weighing.—The milk-record blanks and the scale should be kept in the room where the milk is strained into the cans. The record blank may be placed in a specially designed case equipped with a glass front having a narrow slot through which the entries may be made. If a case is not available, the record blank may be thumb-tacked to the wall and two pieces of celluloid thumb-tacked over it, one piece

Date		Name or Number of Cow											
1	AM												
	PM												
2	AM												
	PM												
3	AM												
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4	AM												
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30	AM												
	PM												
31	AM												
	PM												
Total													
Av.													
Test													
Lbs.													
Fat													

FIG. 27.—SAMPLE MILK-RECORD SHEET

This form may be used in the barn for recording the milk production of each cow for each milking during the month. It is assumed that the milk is to be weighed to tenths of a pound, the tenths to be recorded in the narrow column.

over the upper part and the other over the lower, these pieces being moved every day so that all of the sheet except the lines for one day's entries are covered. The object of the glass or celluloid is to prevent soiling of the record by the hands or flies. In case neither glass nor celluloid is available, fasten a strip of paper just below the line next to be filled, to keep the hands from soiling the record. Suspend the scale from a bracket, such as that shown in Fig. 29, or from a heavy wire. The scale should be near enough to the milk-record sheet to be read while the weight is being recorded.

D. Weigh milk from each cow regularly. — If possible, weigh and record the milk from each cow at each milking. When time does not permit of this being done, weigh the milk from each cow on a certain day of each week, or on the first three days of each month. When milk is not weighed every day, note on the milk sheet the date when any cow is turned dry.

There are a number of advantages in weighing the milk

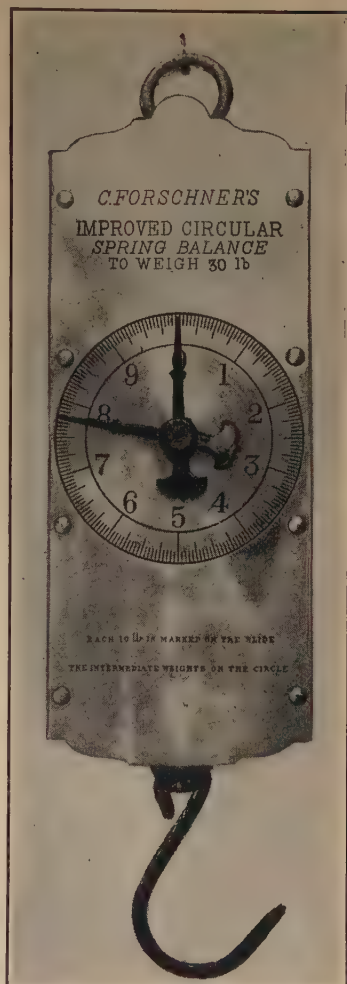


FIG. 28.—SPRING BALANCE FOR WEIGHING MILK OR FEED

Two hands are provided, one of which may be set at zero to balance an empty weigh pail. The weight is then read directly from this hand.

produced by each cow, aside from the fact that this enables the herdsman to compute each cow's total production. Economy in feeding can be secured only when a milk record is available as a guide to the amount of concentrates to be fed. For this purpose, daily weighing is best, but weighing all the milkings on a

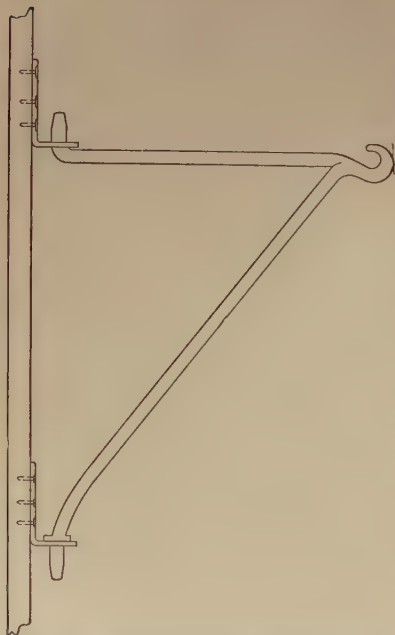


FIG. 29.—BRACKET FOR SUSPENDING
DIAL SCALE

certain day each week may also serve satisfactorily, while weighing but one to three days the first of each month gives approximate results. Regular weighing of the milk also helps to detect quickly any cases of illness, and also faulty milking, either by machine or by hand.

E. Compute milk production for month and year.—Total the weights of the milk of each cow for all the milkings of the month and enter the total at the bottom of the milk sheet. In case the milk has been weighed only a few days in the month, for example the first three days of the month, total the weights for the three days, divide

the total by three, and multiply by the number of days in the month. Now compute the amount of butterfat by multiplying the weight of the milk for the month by the percentage of butterfat as shown by the test. For example, assume that a cow produced 64.5 pounds of milk during the first three days of the month, or an average amount of 21.5 pounds daily. $21.5 \times 30 = 645.0$, the total for the

month. In case any cow was dried off during the month, the average daily production as based on the first three days' weights will, of course, be multiplied by the number of days on which the cow was milked rather than by the number of days in the month. Combine the totals for all the months of the year during which the cow was milked, to find the annual production.

2. SAMPLING MILK FOR BUTTERFAT TESTS

When milk is marketed on the basis of whole milk rather than as butterfat, it is often felt that the percentage of butterfat in the milk, or the test of the milk, as it is termed, is of little importance since the best cows in the herd can be quite satisfactorily selected upon the basis of total milk yield. The test of the milk of different cows within a breed and also within a herd varies so greatly, however, that two cows having the same annual milk yield may differ widely in their yields of butterfat. Likewise, two cows having the same test may differ greatly in their yearly milk production. Both the yield of milk and the yield of butterfat should be known in order to select the breeding stock for the herd.

It should be pointed out that the test of the milk of each cow changes as lactation advances, and is also influenced temporarily by many factors, so that a single test is not a reliable index of the true fat yield. Directions for conducting butterfat tests of milk are outlined in the sections that follow.

Procedure:

- A. Provide sampling equipment.
- B. Make a composite sample.

Equipment:

Sample jars, gummed labels, small dipper, preservative tablets.

A. Provide sampling equipment.—Provide a half-pint or pint jar for each sample of milk to be tested. Jars provided with removable metal covers, such as shown in Fig. 30, are most convenient. Fruit jars having glass covers may also be used. Ordinary milk bottles may be used provided they are kept well covered to prevent evaporation and the entrance of flies.

Fasten on each jar two gummed labels on which the herd number or name of a cow is plainly written.

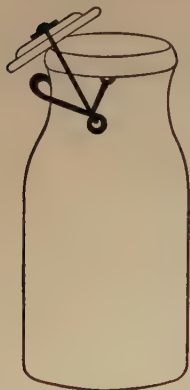


FIG. 30.—SMALL GLASS JAR WITH METAL CAP FOR HOLDING MILK SAMPLES

Secure a small long-handled dipper, such as the one shown in Fig. 31, and also a supply of preservative tablets. The dipper should have not over one-tenth the capacity of the jar. Place one of the tablets in each sample jar. The tablets need not be used when the samples can be kept from souring without them.

B. Make a composite sample.—Take a sample of milk from each of the milkings of each cow during the first three days of each month. In doing this, first stir the milk well with the dipper, after the milk has been weighed and the amount recorded, and while the pail still hangs on the balance. Then place a dipperful of the milk in a properly labeled jar. Place the cover on the jar, and stir the contents by gentle rotation. Repeat this procedure at each milking for the three days. The final, or composite sample, consists of the individual samples taken at each milking.

Such a large number of factors affect the percentage of fat in the milk of an individual cow from milking to milking, such as the length of time between milkings, feed, sickness, etc., that the test of a single milking is not a reliable guide as to the average test of that cow's milk, nor to her yield of butterfat over a period of several days' duration. It is, therefore, neces-

sary to take samples of several milkings in order that the test may serve as a reliable guide.

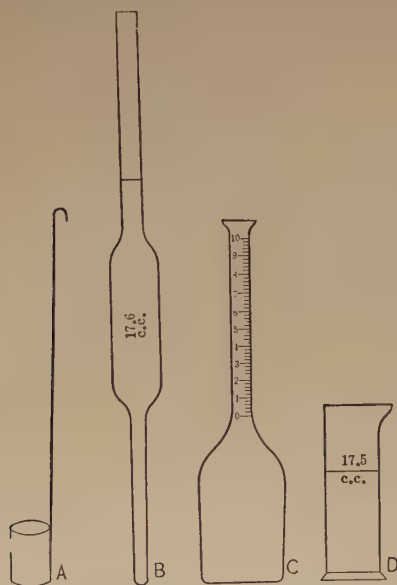


FIG. 31.—EQUIPMENT USED IN TESTING MILK

(a) Small dipper for taking samples; (b) pipette for measuring milk; (c) milk test bottle; (d) glass cylinder for measuring acid.

3. TESTING MILK FOR BUTTERFAT

It is important that the percentage of butterfat in the milk be accurately determined. This may be accomplished most readily by the method described below.

Procedure:

- A. Bring samples to correct temperature.
- B. Mix the sample thoroughly.
- C. Measure milk into test bottle.
- D. Add acid and mix with milk.

E. Whirl the bottles in the tester.

F. Read the test.

G. Clean the bottles.

Equipment:

Milk pipette of 17.6 cc. capacity, milk-test bottles, acid measure of 17.5 cc. capacity, tester, hot water, commercial sulphuric acid, dividers, thermometer, watch or clock, small pail or dish, bottle brush, soap powder.

A. Bring samples to correct temperature.—The milk to be tested must be at a temperature of 55° to 65° F. to give the best results. If it is not at this temperature, place the jars containing the composite samples either in warm water or in cold water, as the case may require, while the rest of the equipment is being made ready. Be careful not to place jars containing frozen milk in very hot water on account of the danger of breaking the jars and thus losing the samples.

B. Mix the sample thoroughly.—When the samples have reached the right temperature, mix the first sample to be tested by pouring it several times back and forth from the sample jar into a clean jar or dish. Be sure that any lumps of cream or curd have been broken up. Make the last transfer into the original jar bearing the label.

C. Measure milk into test bottle.—As quickly as possible after mixing the sample, place the mouth over the large end of the pipette and draw the milk up above the mark. Take the pipette from the mouth, at the same time quickly placing the dry forefinger over the end of the stem to hold the milk in the pipette. Permit the milk to run down to the mark, by lifting the finger slightly. Hold the test bottle at an angle, insert the pipette about an inch, and allow the milk to run slowly down the side of the bottle. Blow the last drop from the pipette. When using the modern type of pipette having a small stem, the stem is inserted full length into the bottle and the pipette allowed to drain. If any milk is spilled while transferring the milk to the test bottle, measure the milk into the



FIG. 32.—A COW TESTER AT WORK

A traveling cow tester with portable outfit. After pouring the milk from one jar to another to mix it thoroughly, the tester measures a sample by drawing the milk up into a pipette.

pipette again and place in a clean test bottle. Label the test bottle on the roughened area with the herd number of the cow or the number of the sample.

For accurate results, make the tests in duplicate, and if the duplicates do not check closely, repeat the test. Save the samples of milk being tested until the tests have been completed.

D. Add acid and mix with milk.—Measure out 17.5 cc. of commercial sulphuric acid, which should be at about the same temperature as the milk (55° to 65° F.), by use of the glass acid measure or dipper, and pour it slowly and carefully down the side of the test bottle, while holding the bottle at an angle. Rotate the bottle slowly, so that any milk in the neck of the bottle will be washed down. When this has been correctly done, the acid should form a clear layer below the milk.

Mix the milk with the acid by shaking rapidly but gently with a rotary motion, being careful not to splash the mixture up into the neck of the bottle. Continue the shaking until the liquid becomes a dark brown color and all the curd has been dissolved. Great care must be used in handling the acid as it is very poisonous and injurious to skin and clothes. In case any acid is spilled on the hands or clothes, wash as quickly as possible with cold water. If burns to the hands result, apply some baking soda and leave it on for a time, then apply a healing salve.

E. Whirl the bottles in the tester.—When all the composite samples have been prepared in test bottles, as described, place the bottles in the tester, arranging them opposite each other so that the weight in the tester is distributed evenly. Start the tester carefully and gradually increase the speed. Turn the crank, at the number of revolutions per minute indicated on the tester, for five minutes, and allow the machine to come to a stop gradually. Without removing the bottles from the machine, fill each of the bottles nearly to the neck with hot soft water, or hot tap water to which a few drops of sulphuric acid have been added, using either the pipette or a specially designed cup, such

as shown in Fig. 33, for the purpose. Whirl the bottles again for two minutes. Again add hot water to each bottle until the liquid in the bottle comes within half an inch of the upper end of the graduated scale. Whirl the bottles again for one minute.

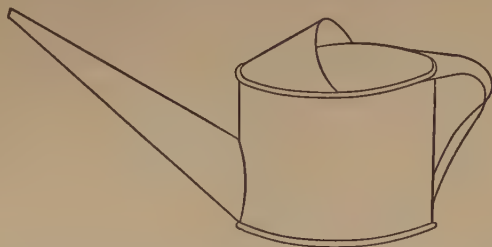


FIG. 33.—CUP FOR ADDING HOT WATER TO TEST BOTTLES

F. Read the test.—Remove the bottles from the tester and place them in a small pail or dish which contains hot water of sufficient depth to reach the tops of the fat columns in the test bottles. The water should have a temperature of 135° to 140° F. Leave the bottles for several minutes, until their contents have attained the temperature of the water, when the test is ready to be read. Remove one bottle at a time from the water bath and read promptly.

Hold the bottle at about the level of the eye and in a strong light. Note the number of graduations covered by the fat column. Dividers, used as shown in Fig. 34, simplify the taking of the reading. The large graduations on the bottle shown in the figure represent 1 per cent, while the smaller graduations represent two-tenths of 1 per cent (0.2 per cent). The fat column illustrated in the figure, therefore, shows a test of 3.6 per cent, which means that each 100 pounds of milk contains 3.6 pounds of butterfat. Record each test before reading another.

The "8 per cent bottle," now in common use, is graduated to one-tenth of 1 per cent (0.1 per cent) instead of two-tenths per cent as in the case of the older "10 per cent bottle."

NOTE.—Suggestions regarding butterfat tests.—It will be noted that both the top and the bottom of the fat column are somewhat sunken in the center. The correct reading is taken by reading to the extreme upper and lower limits of the column.

The fat column, at the time the test is completed, should be a clear yellow color and contain no charred flaky material.

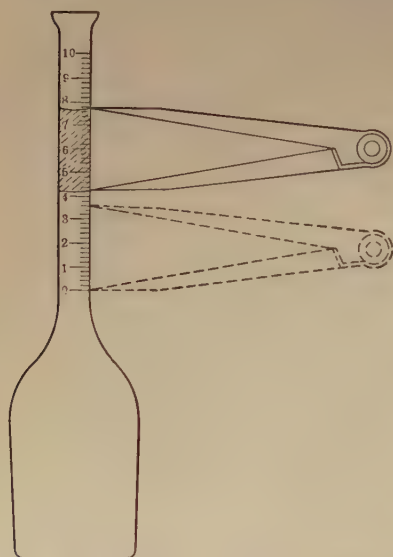


FIG. 34.—METHOD OF USING DIVIDERS IN READING FAT COLUMN

The dividers are placed on the neck of the bottle so that the points are opposite the limits of the fat column. Without change in spread, they are moved on the scale so that the lower arm is at the zero mark. The upper arm then indicates the percentage of fat.

Fat columns containing dark material and lacking uniformity indicate that the acid used was too strong, or that either the milk or the acid was too warm. In making further tests, have the milk and acid at a temperature of 55° to 65° F. Fat columns that are light greenish or gray in color, or are cloudy, with particles of undissolved curd in them, are the result of using too little acid or of using milk or acid too cold. Black flakes may result from the use of too much acid.

Bubbles occurring at the top of the fat column, making reading difficult, are usually the result of using hard water to fill the bottles. Soft water should be used, or hard water may

be boiled or treated with a few drops of sulphuric acid to precipitate the minerals and thus prevent the trouble.

G. Clean the bottles.—Clean the bottles soon after the test has been completed. Empty the liquid into a stone jar or on the ground where animals do not have access to it. Do not

pour the liquid into sinks unless these are stone, or lead-lined, and equipped with lead waste pipes. Rinse the bottles with warm water, then shake some soap powder into each and brush out the necks by means of a bottle brush and hot water. If some sediment adheres to the bottle, dissolve with a little acid, then rinse out. Rinse in clear water and invert to dry.

4. CALCULATING BUTTERFAT YIELDS

If the monthly milk production has been computed as previously directed, it will be a simple matter to calculate the yield of butterfat.

Procedure:

- A. Compute milk production for the month.
- B. Calculate butterfat production for the month and year.

A. Compute milk production for the month.—Compute the production of milk for the month in the same manner as outlined in Section 1 above.

B. Calculate butterfat production for the month and year.—Having obtained the monthly yield of milk and the average test, compute the number of pounds of butterfat as follows: The amount of milk for the month was 645 pounds and the test 4.5 per cent. Then $645 \times .045 = 29.025$, the number of pounds of butterfat produced during the month. Total the production for the different months to find the yield for the year.

5. DETERMINING MILK AND BUTTERFAT YIELDS THROUGH THE AGENCY OF A COW-TESTING ASSOCIATION

Cow-testing associations or herd-improvement associations are in operation in most states. These associations are conducted upon a cooperative basis. Usually about twenty-six dairymen located in a county or community form a cooperative

organization which hires a qualified person to secure yearly production records.

The tester spends one day a month at each farm. He records the amount and value of the feed each cow receives, and weighs and tests her milk. He calculates not only the production of milk and butterfat for each month and the year, but also the profit and loss from each cow. He may also offer suggestions regarding the feeding and management of the herd.

Cow-testing associations have been a very important factor in eliminating the lowest-producing cows in the herds tested, thus raising the standard of production and greatly increasing profits. In most states these associations are under the supervision of the college of agriculture of the state university. Aid in forming such associations may be obtained by writing to that agency.

6. MAKING ADVANCED REGISTRY OR REGISTER OF MERIT RECORDS

Records of milk and fat production which exceed certain minimum standards and which are made under the supervision of an agency designated by a breed association are accepted by that association as Advanced Registry or Register of Merit records. The method of determining the milk and butterfat yields of each cow is similar to that of the cow-testing association except that the supervision is stricter.

In most states, the college of agriculture or agricultural experiment station of the state university supervises, for the breed associations, the making of records within the state. Detailed information regarding these records may be secured by writing to the main offices of the breed associations or to the state university.

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COMMUNITY STUDIES

Secure from a farm adviser, county farm bureau agent, local cream station, condensery, milk shipping station, or some similar agency, the names of a number of farmers in your community who are selling relatively large amounts of dairy products. Visit as many of these farms as possible and secure answers to the following questions.

1. Are milk records of each cow kept?
2. Are these records kept by the farmer and his own help?
3. Are the records kept by the tester of a cow-testing station?
4. Are any Advanced Registry or Register of Merit records being made?
5. During how many days of the month is the milk of each cow weighed?
6. What kind of scale is used for weighing the milk?
7. How are milk weights kept? (Weekly record sheet, monthly record sheet, bound book?)

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8. Is the milk of each cow tested for butterfat? If so, by whom?
9. From how many milkings are samples taken for testing?
10. Is a preservative used in the samples? If so, what kind?
11. How large a tester is used? (Number of test bottles it will hold?)
12. How often is milk of each cow tested?
13. How often is the amount of milk or butterfat produced by each cow computed?
14. Have any cows been sold from the herd because record keeping has shown them to be unprofitable?
15. Have better prices been secured for cows or their calves because records had been kept?

CHAPTER V

BUYING AND SELLING DAIRY CATTLE

There is, and probably always will be, a marked tendency to traffic in dairy cattle. The beginner must buy some cattle in order to establish his herd, and the owner of an already well-established herd frequently finds it necessary to sell some of his surplus animals in order to keep his herd the proper size. Whether the dairyman buys or sells—and he will be obliged to do some of both in the management of a herd—he should understand at least some of the principles of marketing in order to be able to protect himself, as well as those with whom he deals.

Operations:

1. Buying only good, sound, healthy cattle
2. Selling cattle by the best methods.
3. Replenishing the herd by growing young stock.

1. BUYING ONLY GOOD, SOUND, HEALTHY CATTLE

The risk in buying cattle is necessarily high. Careless purchasing will frequently result in loss and disappointment. Even with the most careful attention to details, animals will not always develop according to expectations.

Procedure:

- A. Determine definitely the kind of cattle you want to buy.
- B. Find the average selling price of such animals.

- C. Obtain information regarding reputation of breeders.
- D. If inexperienced, obtain opinions of experienced men.
- E. Be sure of the health of the herd from which you buy.
- F. Insist on a tuberculin test.
- G. Buy only superior animals.
- H. Quarantine animals before putting them into your herd.

A. Determine definitely the kind of cattle you want to buy.—Before you approach a dairyman from whom you expect to buy, decide on the type of animal that will best serve your purposes. Do you wish to buy heifers just coming into milk, or is the demand for milk such that you need mature cows which have reached their highest yield? Is it advisable to purchase cows for October calving and winter production, or would it be best to utilize pasture with cows that calve in May? All such questions should be answered before the purchase is made. Occasionally one will find that cows of a particular kind or in a certain stage of lactation are in such great demand that the price has become prohibitive. In such cases it may be advisable to purchase cattle that are in less demand and therefore priced nearer their actual value.

B. Find the average selling price of such animals.—After deciding on the type or kind of cattle that you desire to obtain, determine the average selling price for such animals. This can be done by consulting dairy papers for sale reports, by correspondence, or by getting the opinions of dairymen and farmers. While the market for both grade and purebred cattle is becoming somewhat standardized, there are rather wide differences in the value of individuals. It is usually desirable to obtain prices on animals in several herds before making purchases. In this way comparisons between animals can be more readily made and values more accurately determined.

C. Obtain information regarding reputation of breeders.—There is great opportunity for deception on the part of owners in the selling of their cattle. It is therefore advisable to obtain

information regarding the character and honesty of a breeder before effecting a purchase. Such information can usually be obtained from bankers, business men, breed associations, or nearby dairymen. It is never a good practice to deal with dishonest breeders or dealers.



FIG. 35.—PRIZE WINNERS

A member of the Sheriday Jersey Calf Club and her first-prize Jersey heifer, "Carnation Trixy," in the senior calf club contest at the Indiana State Fair. Many disappointments might be avoided if good individual animals were secured for club members.

D. If inexperienced, obtain opinions of experienced men.—One does not become skilled in the buying of cattle except by experience. The inexperienced person who lacks confidence in his own judgment should obtain the opinions of some experienced and successful dairymen and be guided by their judgment. Observe carefully the points which they regard as especially significant in the purchase of an animal.

E. Be sure of the health of the herd from which you buy.—Perhaps more dissatisfaction and disappointment have resulted from the purchase of animals from unhealthy or infected herds

than from any other cause. Too much emphasis can not be placed on this one fact. The status of the health of the herd may be determined in several ways. The two diseases that are most common and most generally feared in the purchase of cattle are tuberculosis and infectious abortion. The presence of the former disease can be detected with almost absolute certainty by means of the tuberculin test. Infectious or contagious abortion can not be so readily detected and is in reality more to be feared.



FIG. 36.—GOOD QUARTERS MAKE FOR HEALTHY CATTLE

Barns which are clean and well ventilated are conducive to the rearing of healthy cattle. Note the large number of windows and the ventilator near each window. Silos and separate feed-storage barn are shown near by. This figure illustrates an excellent one-story barn.

Herds that are in normal health should produce almost as many calves per year as there are cows in the herd. About 50 per cent of the offspring will be bull calves, most of which will be disposed of at an early age. One would therefore expect to find about half as many heifer calves under one year of age as there are cows in the herd. Failure to do so should lead the purchaser to seek the cause. The facts regarding this condition can usually be obtained indirectly, by judicious questioning.

Whenever possible, it is advisable to have the blood of the animal that one intends to purchase tested for the presence of abortion by the agglutination or complement-fixation tests. A reaction to either or both of these tests should cause the rejection of the animal.

F. Insist on a tuberculin test.—Most states now require that all cattle brought across the borders of the state, except those intended for slaughter, be tested for the presence of tuberculosis. Cattle for breeding or dairy purposes should never be purchased without having been tested and pronounced free from tuberculosis. Furthermore, such animals should be purchased subject to a sixty- to ninety-day retest. In case of a reaction during that period the seller should stand the loss.

It is important that the test for tuberculosis be accurately and honestly applied. For this reason it is desirable to have animals tested under the State and Federal Accredited Herd Plan.

G. Buy only superior animals.—In most cases only superior animals should be purchased. It is better to purchase a few good animals than to use the same amount of money for a larger number of inferior ones. When one takes into consideration the high price of animals and the cost of shipping them, it is not good economy to purchase inferior individuals.

H. Quarantine animals before putting them into your herd.—When one has a clean herd there is always some risk incurred by the introduction of an animal from another herd. It is therefore advisable to quarantine newly purchased animals until they can safely enter the herd. A quarantine of this nature usually covers from sixty to ninety days, which makes possible a retest for tuberculosis and contagious abortion.

2. SELLING CATTLE BY THE BEST METHODS

In this country there are two common ways of buying or selling cattle. These are by private treaty or through the public

auction. The former method is the more common though the latter is coming to be extensively used. In either case it is important for the seller to make known to the prospective purchaser just what he has for sale.

Procedure :

- A. Advertise in agricultural periodicals.
- B. Use circular letters and correspondence.
- C. Make use of good pictures.
- D. Make a special effort to satisfy customers.
- E. Sell through dispersal sales or well-managed consignment sales.

A. Advertise in agricultural periodicals.—Because of their extensive circulation, agricultural papers are almost sure to reach prospective purchasers. Advertising in newspapers or in breed publications or trade journals must be skilfully done. In such cases, specific sale announcements or references to individual animals are most effective. Care must be taken that the cost of advertising is not out of proportion to the value of the animals advertised. In such advertisements, as elsewhere, it is necessary to state the truth regarding the animals listed.

B. Use circular letters and correspondence.—Carefully prepared circular letters, when sent to a select mailing list, constitute valuable advertising. Such letters usually take the form of special sale lists and briefly describe each animal that is offered for sale.

Even when newspaper advertising or circular letters are responsible for inquiries, it is almost always necessary to close the deal by means of a letter or by a personal interview. The ability to write attractive and convincing letters is an asset to any breeder, and especially to the owner of purebred cattle. While letters should be brief and to the point, they should state all the facts that would be of interest to the purchaser. Furthermore, all correspondence should be answered promptly, preferably within twenty-four hours after it is received.

C. Make use of good pictures.—Most breeders and dairy-men do not make sufficient use of good pictures. There is no description, no matter how accurate, that is quite so convincing as a good clear picture of an animal. It is not necessary that such photographs be elaborate or costly. An ordinary kodak picture is sufficient if the animal is standing in a good pose and if taken at a time when the animal shows to advantage.

D. Make a special effort to satisfy customers.—A satisfied customer is one of the best advertisements a breeder can have. In selling animals be especially careful of the accuracy of all statements made. Understate rather than overstate the desirable characteristics of an animal. Mention defects that might be overlooked by a purchaser. The prospective buyer will appreciate your honesty in pointing out such defects and will be more willing to deal favorably with you. A sale made under misrepresentations can not mean a satisfied customer and will react unfavorably on your business.

E. Sell through dispersal sales or well-managed consignment sales.—Breeders who have only a few cattle to dispose of each year find it convenient to combine with their neighbors and market their cattle by means of a consignment sale. Such a method of marketing has the advantage of marketing the cattle at a definite time and usually to a favorable market. Dispersal sales are usually convenient ways of selling the entire herd when one is going out of the business. Such sales attract more and better buyers than consignment sales when cattle of equal quality are sold. Under such conditions the purchaser knows that he has an opportunity to buy the best animals in the herd. Such animals are seldom offered in a consignment sale.

It is seldom advisable for a beginner to buy at an auction sale. A great deal of enthusiasm prevails under such methods of selling and the inexperienced buyer is very likely to be unduly influenced by a clever auctioneer and pay more for an animal than one of equal merit could be purchased for at private sale.

3. REPLENISHING THE HERD BY GROWING YOUNG STOCK

It is the practice in certain milk-producing sections to replace members of a herd by purchase. Such a method is not generally productive of improvement in the herd and takes away the opportunity to increase production by means of better methods of breeding. Many breeders who depend upon replenishing their herds in this manner have not been able to increase production over what it was ten or fifteen years before.

The purchaser of cattle is always at a disadvantage because he has had no opportunity to know the characteristics of an individual but must depend entirely upon what he can see of the animal. There is also the danger of introducing disease by purchased animals, as well as the difficulty of getting a breeder to dispose of his better individuals.

Furthermore, there is constant depreciation in herds where older animals only are purchased, whereas there is a tendency for young animals to increase in value as they grow to maturity.

It has been found that three heifers must be grown each year from each ten cows kept, in order to insure the maintenance of the herd at its original size. It is only by keeping heifer calves from the best-type, highest-producing cows that the greatest possible improvement can be made in the development of a herd.

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CHAPTER VI

IMPROVING THE DAIRY HERD

It is a fundamental principle that the cost of production bears an inverse ratio to the amount of production. Stated in another way, as production increases, other factors remaining constant, the cost of producing a given unit decreases. It is therefore extremely important to have cows capable of making high milk and fat yields.

The average annual production of dairy cows in the United States is low. It has been estimated that dairy cows in this country yield on an average less than 4000 pounds of milk annually. Government estimates for the year 1920 place the production even lower, 3627 pounds of milk per cow. Such yields are entirely too low and are probably only sufficient to equal the total expense of keeping the cow. Yields in excess of those given above are necessary under most conditions, before the business of dairying becomes a profitable enterprise. Many countries have already demonstrated that it is possible to develop cattle which yield an average production much beyond that found in this country (see page 38).

The ability of a cow to yield milk and butterfat is the result of two factors. These are environment,¹ or the conditions under which the animal is forced to exist, and heredity, or the inherited ability which she derives from her ancestors. Environment alone is responsible for the increased production of animals already in existence and also makes possible the

¹ The influence of environment is fully discussed in Chapters IX-XIV, inclusive, and methods presented for increasing production by improving the environment.

actual production where adequate hereditary capacity is found. Heredity can not be used to improve the production of cows already in existence, but may be employed, through the application of our knowledge of its laws, in the production of future generations of animals possessing the inherent or potential ability to produce higher yields.

Operations:

1. Eliminating the low-producing cows.
2. Choosing the proper sire.
3. Practicing rigid selection.

1. ELIMINATING THE LOW-PRODUCING COWS

One of the first steps toward improving a herd already in existence is the elimination of unprofitable and undesirable animals.

Procedure:

- A. Eliminate all diseased and badly blemished animals.
- B. Sell unprofitable cows.
- C. Retain promising animals.

A. Eliminate all diseased and badly blemished animals.—

If the herd has not previously been tested for tuberculosis, this test should be made at once. If possible, test under the Federal Accredited Herd Plan and follow instructions carefully. In case there are any animals that react to the test, dispose of them and disinfect the premises and barns thoroughly. At the same time, dispose of any animals so badly blemished as seriously to impair their usefulness. An example of such a blemish would be a defective udder having two or more quarters that do not produce milk. Badly crippled animals might also be included in this group.

B. Sell unprofitable cows.—Almost every herd has some animals that a test for milk and butterfat production shows to be unprofitable. Such animals should be sold for beef and not

turned over to someone else for dairy purposes. The higher the standard which you hope to attain in your herd, the more rigid you must be in eliminating animals that are shown to be unprofitable. It is, of course, necessary to exercise judgment in disposing of unprofitable animals. For no apparent reason, a really good animal will occasionally have a bad lactation. In such doubtful cases it is usually desirable to wait for a second calving before selling the animal.



FIG. 37.—JERSEYS AT PASTURE

The refinement, symmetry, and colorings of the Jersey cause it to be recognized as the most beautiful of the dairy breeds. "Beauty and utility" is one of the slogans of Jersey breeders.

C. Retain promising animals.—The better animals should be retained for breeding purposes. Applying the standards of selection described in Chapter II, pick out those animals which most nearly fulfil the requirements of a desirable dairy cow. In case there are good producers of undesirable type, it may be advisable to keep them in the herd. The offspring from the most desirable cows should be saved for building the future herd.

2. CHOOSING THE PROPER SIRE

Too much emphasis can not be put upon the selection of a sire. No other single investment in animals is so important in determining the future producing ability of the herd. The proper sire will make possible the development in a few years of a high-class herd, but a poor sire may almost ruin the future of an already well-established and high-producing herd. The influence of a sire in building up a herd is very well illustrated by an experiment conducted at the Iowa Agricultural Experiment Station, Ames, Iowa.²

For this experiment, inferior (scrub) cows of a very low level of production were purchased in Arkansas. So far as was known, no improved blood occurred in the immediate ancestry of any of these cows. The cows were then brought to the Iowa State College and given good feed and care. They responded to their new environment and increased their production considerably above what it was in Arkansas. These scrub cows were then mated to high-class purebred bulls and the production of the offspring determined. The scrub cows, when well fed and cared for, produced 3847 pounds milk and 182 pounds fat. Their daughters by purebred sires averaged 5945 pounds milk and 262 pounds fat, or an increase of 55 per cent in yield of milk and 44 per cent in butterfat. The third generation, also sired by purebred bulls, averaged 8311 pounds milk and 376 pounds fat, or an increase of 116 per cent in milk yield and 106 per cent in yield of fat over their scrub grandams.

It is clearly evident from this experiment that the sire is capable of raising the production of his daughters much above that of their dams. All sires, however, do not possess this ability to the same degree. The problem, then, is to secure the proper sire.

² Iowa Buls. 165, 188; Jour. of Dairy Science 4, 1921, pp. 12-23.

Procedure:

- A. Whenever possible, select a tried sire.
- B. Avoid non-breeders and diseased animals.
- C. Use tried sires extensively.
- D. If necessary, select a younger sire.
- E. Choose a young sire on the basis of his ancestry.
- F. Pay special attention to the individuality of a young sire.
- G. Select a young sire whose dam and sisters have production records.
- H. Purchase sires cooperatively when possible.

A. Whenever possible, select a tried sire.—It is generally conceded that the purchase of a tried sire affords the least risk to the purchaser. By a tried sire is meant one whose daughters have already proved their value as producers of milk and fat. Furthermore, by comparing the individuality of the daughters of such a sire with that of their dams (or mothers) it is possible to judge to what extent the sire has influenced the individuality of his daughters. Fortunate indeed is the breeder who is able to locate a good tried sire at a reasonable price.

There are naturally some disadvantages in purchasing an older sire. In many instances such sires are large, have bad dispositions, are difficult to handle, and are generally objectionable to have on the farm. In such cases it is necessary to provide suitable quarters where the bull can be kept without frequent handling or danger to attendants. A pen suitable for this purpose is described in Chapter XIII. The cost of such a pen and the inconvenience of handling an aged bull is more than offset by the value of such a sire.

B. Avoid non-breeders and diseased animals.—In buying a mature sire, one must be especially careful to deal with a reputable owner and obtain a guarantee that the animal is a breeder. It must be borne in mind that older bulls should be shipped only when absolutely necessary, as shipment, even for a

short distance, may put them out of service for from three to six months.

The relation of the sire to the spread of infectious abortion is not well known. It is advisable, however, before the animal is purchased, to have his blood subjected to the agglutination test in order to determine whether or not he is infected with the abortion organism. In case he reacts to the test, it is doubtful whether he should be used in a herd that is free from that disease.

C. Use tried sires extensively.—Good proved sires should have an opportunity for extensive service. Fig. 38 shows four



FIG. 38.—FOUR DAUGHTERS OF ONE SIRE

Four of the first five daughters of Sir Bess Pietertje Piebe. Average yearly production with first calves, at an average age of two years and five months, 18,180 lbs. milk and 629 lbs. butterfat. Photograph taken when animals were all milking with first calves. Note large size, splendid type, and great capacity.

daughters of a sire. Their average production with first calves at an average age of two years and five months was 18,180 pounds milk and 629 pounds fat. Their size, splendid individuality, and capacity for high production make them especially valuable.

A sire of this type would improve almost any herd, and it would be difficult to estimate his value.

There is a tendency on the part of many breeders to dispose of a sire for beef when he is three or four years old, and before the value of his daughters is really known. This is not a desirable practice, as good bulls should be kept in service as long as possible. The skilful breeder will take advantage of such opportunities to purchase the best bulls when their owners seek to dispose of them at this age.

D. If necessary, select a younger sire.—It is not always possible or desirable to purchase an older or proved sire. When this can not be done it becomes necessary to select a younger animal. In this case the age of the animal is not important except that it is possible to tell more about the development of older animals. The transmitting ability of a young bull always remains a question until his daughters are milking. Not all of the promising young bulls make high-class sires. Even with the most careful attention to details in selection and after an exhaustive study of the ancestry and individuality of the animal, disappointments may occur.

E. Choose a young sire on the basis of his ancestry.—While it is important to know the parentage of any animal, this is especially true of bulls. We know from our experience in breeding and developing animals that individuals tend to reproduce other individuals like themselves. This is a natural process and serves as a basis for all future breeding operations. If one is familiar with the ancestors of an animal, one can form a reasonably accurate opinion as to what to expect from the individual and its offspring. While there is occasionally an individual that does not breed true to its type or to that of its ancestors, the great majority follow somewhat after the ancestral types.

It is usually unnecessary to go back of the grandparents to study ancestry. Chart 3 shows the ancestral record or pedigree for two generations of the bull whose daughters are shown in Fig. 38.

Sir Pietertje Ormsby Mercedes 37th—110160		Sir Pietertje Ormsby Mercedes—44931	
38 A.R.O. Daughters		77 A.R.O. Daughters	
Princess Merc.		Queen Piebe	
Jewel Orms.,		Merc., 4 yrs.	
3½ yrs.		1389.45	
Milk.		Milk (world's	
610.40		records)	
Butter, 2½ yrs.		30230.20	
21.69		Glen Canary D K	
Ponderosa Grace		2d, 4 yrs.	
Piet. Orms., 4		1323.36	
yrs.		Col. Piet. Lass.	
35.02		1265.72	
(Wis. state record)		Bess Piet. Orms.	
Milk.		Merc.	
627.40		1235.32	
Butter, 365 days.		Milk (world's	
971.89		record when	
Butter, 3 yrs.		made)	
27.62		29053.20	
Butter, 2 yrs.		Spring Brook Bess Burke	
25.74		2d—131387	
Bess Joh. Piet.		Butter, 7 days, 6	
Merc., 4 yrs.		yrs.	
32.82		38.22	
Butter, 7 days, 3		Milk.	
yrs.		792.30	
30.10		Butter, 365 days.	
Butter, 365 days.		1034.33	
1072.60		Milk.	
(Wis. state record)		21552.90	
Milk.		Butter, 30 days.	
23360.00		154.73	
Wis. Fobes 5th,		Butter, 5 yrs.	
2½ yrs.		36.12	
29.68		Butter, 365 days.	
(Wis. state champion for		1044.91	
heifer with first calf)		Butter, 8 yrs.	
		35.94	
		Butter, 365 days.	
		1290.94	
		Butter, 10 yrs.	
		30.22	
		Butter, 365 days.	
		1053.97	
Sir Bess Pietertje Piebe No. 204840		Sir Piebe Aaggie Hen- gerveld—32492	
Born Sept. 19, 1916		22 A.R.O. Daughters	
His sire's three		Princess Aaggie	
nearest dams		Piebe, 4½ yrs.	
average:		29.32	
Butter, 7 days.		Butter, 365 days,	
36.19		2½ yrs.	
Butter, 365		470.50	
days.		Piebe Glen Rose,	
1048.07		4 yrs.	
His sire is a full		26.72	
brother to:		Wis. Lass 2d, 5½	
Bess Johanna		yrs.	
Ormsby, 4		26.49	
yrs.		Butter, 365 days.	
40.74		808.16	
Butter, 305		Princess Jane Mercedes	
days.		—90846	
Milk.		Butter, 7 days, 4½	
21380.50		yrs.	
		18.23	
		Milk.	
		474.10	
		Butter, 365 days,	
		5½ yrs.	
		909.97	
		Milk.	
		21611.70	
Princess Mercedes Piebe —124232			
Butter, 7 days, 4			
yrs.			
26.39			
Milk.			
561.50			
Butter, 7 days, 2			
yrs.			
18.19			
Milk.			
397.00			
Butter, 365 days,			
2 yrs.			
667.40			
Milk.			
17400.70			
2 A.R.O. Daughters			
Princess Merc.			
Piebe 3rd.			
25.22			
Milk.			
703.10			
Butter, 30 days.			
104.22			
Butter, 305 days,			
2 yrs.			
515.95			
Princess Merc.			
Piebe 2d, 2 yrs.			
17.03			
Milk.			
369.80			

CHART 3.—A SPECIMEN PEDIGREE

It will be observed that every cow in this pedigree has a record of production, and each sire has produced daughters with good milk and fat yields. Such ancestry would lead one to expect a certain transmitting ability from the sire himself. Not only the productive capacity, but also the individuality of the ancestors should be known. In respect to individuality, it is desirable to determine the type which they possess, the shape and quality of the udders of the cows, etc. While ancestry is important in the selection of a sire, all these other factors must also be taken into consideration.

F. Pay special attention to the individuality of a young sire.—The individuality of the sire is more important than that of any other single member of the herd. This is true for two reasons: first, the influence of the sire is equal to the combined influence of all the cows with which he is mated; second, breeders and dairymen generally judge the value and importance of a herd to a considerable extent by the quality of the sire at its head.

Select a sire that shows the evidences of dairy tendency, described in Chapter II for cows. Furthermore, choose one that is deep of body, deep and broad of chest, with evidences of a strong, robust constitution and an ample feeding capacity. The sire should be straight and strong in the back and long and level in the rump. The rump should also be broad and the pin bones far apart. Figs. 19, 20, 21, 23 picture bulls of the different breeds which have been selected by many breeders and judges as exemplifying excellent types for the breeds which they represent. Immature bulls show less development and less depth and width, but are in general of similar type. It is not so important in a tried sire to stress individuality. In his case the quality of his daughters is already known. When the daughters of a bull are especially desirable, inferior qualities in the sire can be overlooked.

G. Select a young sire whose dam and sisters have production records.—It is important to know the production records of the mother and sisters of an untried sire. While the sire himself does not function in production, he has the capacity to

transmit that ability to his daughters. This ability is inherited from his ancestors and must be evaluated in his case by their performance. A knowledge of the record of the dam, together with a knowledge of the way in which it was made, is valuable in determining the transmitting ability of the son. The record of the dam need not be extremely large in all cases but it should be made under normal conditions and on milkings made twice a day. Large records, however, are more valuable



FIG. 39.—SAID TO BE "THE GREATEST MOTHER OF THE BREED"

A large cow of excellent type, record 25,227 lbs. milk and 875 lbs. butterfat. Mother of three cows which average 26,672 lbs. milk and 984 lbs. fat in 365 days. Productive capacity and reproductive ability are highly developed in this animal.

in purebred animals because they tend toward a larger increase in values. The production of the daughters of the sire is also important in determining his effect on the transmission of the characters of milk production. A sire that transmits high production to his daughters will, it is assumed, also transmit those characteristics to his sons.

Certain studies with plants and with animals other than cattle have shown that it is necessary to distinguish between productive ability and the capacity to transmit that ability.

In other words, the fact that a cow can make a large record (which is productive ability) does not necessarily mean that she can transmit such productive ability to her sons and daughters. It is, therefore, important to know the production of the sisters (preferably full sisters) of the sire under consideration. If their records are consistently high it may be presumed that this ability will be transmitted to the offspring.

H. Purchase sires cooperatively when possible.—There are three very good reasons why small breeders do well to purchase a sire in cooperation with their neighbors: First, they can in this way obtain the services of a better sire at a lower original cost than would otherwise be possible. Second, the sire can have more extensive and longer use and become better known. Third, this practice develops similar blood lines in a community, advertises the community more extensively, and attracts more resident buyers who are interested in similar lines of breeding.

3. PRACTICING RIGID SELECTION

An American who was traveling in England was greatly impressed with the results of some coursing contests in which the winners were almost invariably from the same kennels and bred by the same breeder. The American, interested in finding out the reason for the unusual success of these particular kennels, approached the owner and inquired regarding the methods of breeding which were so uniformly successful. The Englishman in his quiet, unassuming manner answered, "The answer is easy; I breed many and I hang many." And so it is with most successful breeders. They attain their success by rigid selection and by the constant elimination of the less desirable animals.

Procedure:

- A. Select a definite standard of production.
- B. Choose animals of uniformly good type.
- C. Dispose of animals that do not meet these standards.

A. Select a definite standard of production.—It is good practice in building a herd to set a minimum standard of production which cows must equal before they are permitted to remain in the herd. In herds that are well established and properly managed, 250 pounds of fat is not too high a production to expect of the individual mature cow. Here again, however, it is necessary to exercise judgment for occasionally high-class animals, because of abortion or for some other reason, may not reach that production. Young animals, such as heifers milking with first calves, would be expected to produce less, probably 180–200 pounds of fat. In taking a cow's record, it is advisable to consider the calendar year, from Jan. 1 to Dec 31, for instance, instead of the lactation period, since the calendar year includes the dry period when there is a feed cost but no production to be considered.

B. Choose animals of uniformly good type.—There is a growing tendency for breeders and dairymen to favor good individuality in their animals. In fact, it is becoming constantly more difficult to sell, for production and breeding purposes, animals that are poor in type, even though they may satisfy the purchaser in productive ability. Uniformity of type is a valuable asset in any herd. It improves the appearance of the herd and indicates a definite standard on the part of the breeder.

C. Dispose of animals that do not meet these standards.—It takes considerable courage on the part of a breeder to dispose of animals of some value, because they do not meet his standards. But if the highest success is to be attained, it is necessary to eliminate such animals. The better ones may be sold to less discriminating dairymen as the merits of the animals permit. Decidedly inferior animals should be sold for beef.

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CHAPTER VII

CARING FOR AND MARKETING DAIRY PRODUCTS FROM THE FARM

Remarkable progress has been made during the past twenty-five years by manufacturers, milk distributors, and transportation agencies in the handling of milk and cream. During the same period very little improvement has been noticeable in the handling of these products on the farm.

The manufacturer, in spite of modern methods and improved machinery, can not greatly improve the quality of the product which he receives from the farmer. It is to the farmer or dairyman, therefore, that the consumer must look for any far-reaching future improvement. The milk from healthy, normal cows, properly nourished, does not differ greatly in germ content. The difference, therefore, between good and bad milk is largely due to the care and handling of the product. The two common dairy products marketed from the farm are milk and cream. Since they are produced by two different types of dairymen and marketed in different ways to different markets, their care will be considered separately.

Operations:

1. Caring for milk on the farm.
2. Caring for cream on the farm.
3. Marketing milk from the farm.
4. Marketing cream from the farm.
5. Marketing dairy products cooperatively.

1. CARING FOR MILK ON THE FARM

Milk is one of the most important of all food products. It is at the same time one of the easiest to contaminate. It furnishes an ideal medium for the growth of germs. Every producer of milk, therefore, should feel a moral obligation to exercise care in the handling of his product and to keep it free from germs, especially disease germs. He should keep only healthy cows in his herd and they should be cared for by clean attendants who are free from all trace of disease.

In the handling of milk, the following procedure should be observed:

Procedure:

- A. Carefully wash all utensils.
- B. Sterilize utensils.
- C. Clean udder and flanks of cow.
- D. Milk into partially covered pails.
- E. Milk with dry hands.
- F. Strain milk through cotton or gauze.
- G. Cool milk quickly.
- H. Keep milk cool and deliver as quickly as possible.

A. Carefully wash all utensils.—Wash utensils in clean, warm water to which has been added some good washing powder. Wash thoroughly until no trace of milk or dirt is left in any of the creases or dents in the utensils. Be sure to wash all of the utensils that come in contact with the milk, including cans, pails, strainers, dippers, stirring rods, and sampling tubes. Rinse thoroughly in clean, hot, preferably boiling, water.

B. Sterilize utensils.—Clean utensils can be readily and easily sterilized with steam when it is available. Put utensils into a sterilizer and turn on live steam under several pounds pressure, leaving it turned on from ten to fifteen minutes. Cans may be effectively steamed over a steam jet if the sterilizer is too small to accommodate them. Turn a large volume of steam

through the jet into the mouth of the inverted can and allow to remain one minute. Steam the can lid also. Invert the can on a rack and allow to dry before replacing lid.

To sterilize utensils when steam is not available, put one-half to one gallon of a disinfecting solution into a can. Wash the can and all utensils which come in contact with the milk thoroughly with this solution, so that it covers every portion of the interior surface of the utensils. Disinfectants of the chlorine



FIG. 40.—POOR SURROUNDINGS FOR THE PRODUCTION OF HUMAN FOOD

Dairy barns such as this, lacking light and depending upon the cracks in the walls for ventilation, are usually dirty and generally conducive to careless or dirty methods in handling the milk. Note the uncared-for manure heap near the barn. Manure heaps make excellent breeding places for flies during the summer.

group are useful for this purpose and should be used according to the directions of the manufacturer. Drain utensils and allow them to dry. Recent investigations at the University of Illinois indicate that this method of sterilizing utensils is both cheap and effective.

In case it is not possible to sterilize with steam or by means of chemicals as indicated above, it is advisable to rinse utensils with freshly pumped well water just before they are to be used. This rinsing will tend to remove mechanically a great many

germs and thereby reduce the resulting contamination of the milk

C. Clean udder and flanks of cow.—When the udders or flanks of cows have been soiled, remove the loose material with a curry comb or brush and wash with a damp cloth. This will prevent dirt and other material from dropping into the pail during the milking process, and will tend to insure the minimum of sediment.



FIG. 41.—A DAIRY BARN IN WHICH CERTIFIED MILK IS PRODUCED

The wing at the extreme right is a one-story cow barn. At the left is the barn for calves and young stock. In the background are silos and a large feed-storage barn.

D. Milk into partially covered pails.—The value of the covered pail is inversely proportional to the cleanness of the cow. In other words, when the cow is clean the covered pail is not so necessary as when she is not so carefully groomed. The use of the covered pail, however, even with a clean cow, is a safeguard and reduces the opportunity for dirt to get into the milk. Figure 42 shows reduction in bacteria due to the use of a covered pail.

E. Milk with dry hands.—Occasionally an individual imagines it is easier to milk after moistening the hands. Such a practice is decidedly unsanitary and should not be tolerated.

F. Strain milk through cotton or gauze.—Even though extreme care is exercised in the milking process, some sediment is almost sure to get into the milk. Always strain the milk through a cotton pad or a pad of similar material. Do not permit milk to pour directly on to a cotton strainer pad or the cotton may be torn and the sediment released into the milk.



FIG. 42.—A TEST OF THE VALUE OF THE CLOSED-TOP PAIL FOR MILKING

This illustration shows colonies of bacteria grown from milk obtained from a fairly clean cow, milked into a common open-top pail (left) and into a pail with a partly closed top (right). The number of bacteria was reduced nearly three-fourths by the use of the partly closed pail. This demonstration was conducted at Purdue University.

Note in Fig. 43 the device for covering the strainer in order to keep out flies and dirt while milk is not actually being poured into it.

G. Cool milk quickly.—It is extremely important that milk be cooled as quickly as possible after milking. Chart 4 illustrates clearly the effect which cooling has on milk. Normal milk has a natural resistance to the growth of bacteria for some time after it is drawn from the cow. The effectiveness of this resistance is greatly increased if the milk is cooled quickly and held at the reduced temperature.

Figure 44 illustrates one method of cooling milk on the farm. The cans of milk are placed in the tank of water imme-



FIG. 43.—SIMPLE BUT EFFICIENT EQUIPMENT FOR RECORDING MILK PRODUCTION AND STRAINING MILK

A spring balance is used for weighing the milk of each cow. The weight is recorded on a monthly milk-record sheet and the milk is strained into a milk can. Note the clean cloth cover over the strainer to keep out flies. The cover may be quickly lifted by pressing with the foot on the lever near the floor. Note also the covered type of milk pail which helps prevent hair, dirt, etc., from falling into the milk during the milking process.

diately after milking. The warm milk in each can is then cooled by stirring until the temperature is approximately the

same as that of the water in the tank. To keep the milk as cold as possible, it is highly desirable that the water be kept flowing through the tank. This can be accomplished either by the use of flowing spring water if a spring is available, or by pumping well water. In the latter case it is usually advisable to allow the water to flow through the cooling tank to the stock tank.

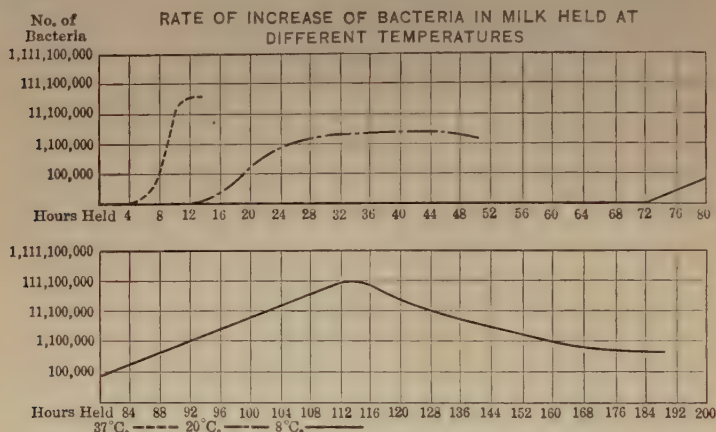


CHART 4.—KEEPING MILK COLD AIDS IN ITS PRESERVATION

The chart shows that milk held at a temperature of 37° C. for twelve hours contained as many bacteria as milk held at 8° C. for four days.

An elaborate cooling tank is not necessary. Where not more than two or three cans of milk are to be cooled, a large barrel cut in half or a small wooden tank will suffice if cool water is kept flowing through it.

A quicker method of cooling milk on the farm is by using a surface cooler. Fig. 5 illustrates one type of surface cooler. In this method, cold running water or a mixture of water and ice is put inside the cooler and the milk flows in a thin film over the outside, cooling quickly. The milk so cooled is then placed in cans in a tank similar to the one described above and held there until delivered. Table VII shows the relative efficiency of different cooling mediums for cooling milk in cans.



FIG. 44.—A GOOD COOLING TANK FOR MILK

The water reaches nearly to the neck of the cans. Partly filled cans may be fastened to the horizontal rail above to keep them from tipping. Cooling tanks are also used in winter to keep milk from freezing. Note, at the end of the tank, the earthenware jars holding disinfectant solution in which milking machine tubes and teat cups are kept between milkings.

TABLE VII

EFFECT OF VARIOUS COOLING MEDIUMS UPON THE RAPIDITY OF COOLING MILK IN CANS

Medium	Temp. Cooling Medium ° F	Temp. Milk ° F	Temp. 1 Hr. ° F	Temp. 2 Hrs. ° F	Temp. 24 Hrs. ° F
Air (milk stirred).....	50	92	87.0	81	
Air (milk not stirred)....	50	92	91.5	86	58
Running water (milk stirred).....	54	92	62	57.5	
Running water (not stirred).....	54	92	72	64	56
Ice water (milk stirred)...	43	92	54	46	
Ice water (not stirred)...	43	92	66	58	44

It is to be observed that cool air is a very poor conductor of heat and therefore a poor cooling medium. Water, on the other hand, is a much better conductor and more efficient as a cooling agent.

Too much importance can not be attached to the cooling of milk. It is almost equal in importance to the sterilization of utensils in the production of milk of low germ content.

H. Keep milk cool and deliver as quickly as possible.—Not only is it important to cool milk quickly and to a fairly low temperature, 50° to 60° F., but it is necessary that milk be held at that temperature until delivered. Delivery, then, should be made as quickly as possible. If it could be made after each milking the highest-quality product would be insured but the added expense would probably be prohibitive. Milk drawn in the evening should be sent to the factory not later than the following morning.

2. CARING FOR CREAM ON THE FARM

The great bulk of cream is produced in small herds, usually of less than ten cows. As in practically all such cases the dairy is a side line bringing in only a small part of the farm income, its management is made secondary to other farm operations. Under such conditions the product is not likely to be marketed in such first-class condition as when dairying is the main issue. In caring for cream on the farm, it is essential that the following procedure be followed:

Procedure:

- A. Clean and sterilize separator.
- B. Assemble separator and prepare for use.
- C. Adjust cream screw.
- D. Separate warm milk.
- E. Cool cream.
- F. Do not mix warm with cool cream.
- G. Market cream frequently.

A. Clean and sterilize separator.—Pay special attention to procedure (A) and (B) in the preceding section on caring for milk, for they apply equally well to cream production. Wash the separator carefully in warm water to which washing powder



FIG. 45.—OPERATING A CREAM SEPARATOR ON THE FARM

Milk can be separated more easily, and separation is more nearly complete, when the milk is at body temperature. Cold milk retards separation and may cause a loss of some cream in the skim milk.

has been added. If a disc machine is being used, wash each disc separately until no trace of milk or sediment remains. Using the same solution, wash the receiving tank and other parts. Sterilize by using steam or disinfecting solution referred to

under (B) above. Rinse the machine thoroughly in hot water (almost boiling) and allow to dry.

B. Assemble separator and prepare for use.—Just before milking time, assemble the machine carefully and be sure that all oil cups are filled with the kind of oil recommended by the separator company. If the weather is cold, run warm water through the machine before starting to separate the milk. Start the machine slowly and allow it to reach the proper speed before turning the milk into the bowl. Be sure that the separator is running at a uniform and proper speed. Test the skim milk by the Babcock method for efficiency of separation.

C. Adjust cream screw.—For convenience and economy in marketing, cream should contain from 40 to 45 per cent butterfat. If cream of a lower percentage is separated, the additional bulk adds to the transportation costs. If cream of a higher percentage is separated some of the butterfat may be left in the skim milk.

To change the percentage of fat of the cream, it is necessary to adjust the cream screw. Turning the screw inward increases the percentage of fat in the cream; turning it outward lowers the percentage of fat. Even though the position of the cream screw remains the same, the cream test will vary.

D. Separate warm milk.—A cream separator will operate more satisfactorily and efficiently if milk is separated at the temperature at which it comes from the cow. When cold milk is separated, some of the fat is usually retained in the skim milk and there is difficulty in obtaining the correct percentage of fat in the cream. It is usually inadvisable to separate milk at a temperature below 70° F.

E. Cool cream.—After separation is complete, run warm water through the separator until the milk and cream are removed. Cool cream as quickly as possible by placing the can in a tub or tank of cold water and stirring. Keep cool until delivered.

F. Do not mix warm with cool cream.—When the quantity of cream separated at any one time is small, it may be necessary

to mix it with other and older cream before marketing. Before doing this, be sure that the new cream has been cooled approximately to the temperature of the older cream. By observing this practice a better product is assured.

G. Market cream frequently.—There is a tendency, principally because cream production is a side line, to market cream at infrequent intervals when it suits the convenience of the farmer. This practice results many times in an inferior product. The more frequent marketing of cream, if generally practiced, would improve the quality of creamery butter and in the long run would react toward a higher price to the farmer for his cream.

3. MARKETING MILK FROM THE FARM

Farmers and dairymen are beginning to display a special interest in the marketing of dairy products. Since the success of the dairy enterprise depends to no small degree upon the disposal of its products, the marketing problem must always continue to demand the attention of the producer. The marketing of milk presents a more pressing problem than the marketing of cream, because the receipts from the sale of milk in most cases are the chief income from the farm. By far the majority of the milk produced is marketed through the general or open market to milk dealers, cheese factories and condenseries. A relatively small amount is marketed by individual dairymen through a special market.

Ways of marketing milk:

A. The general market.

B. Special markets.

(1) Select wholesale.

(2) Retail.

A. The general market.—The general market is an open market. Competition is almost unlimited and the price is reg-

ulated very largely by the supply of milk. The margin of profit to the dairyman is so small that his success in the business must depend upon efficient methods of production. Generally speaking, there is a market for all of the product he cares to produce and he can extend or reduce his business as he sees fit.

B. Special markets.—Near towns and cities there are always a number of individual dairymen who desire to retail their own product. They are interested in exercising special care in the

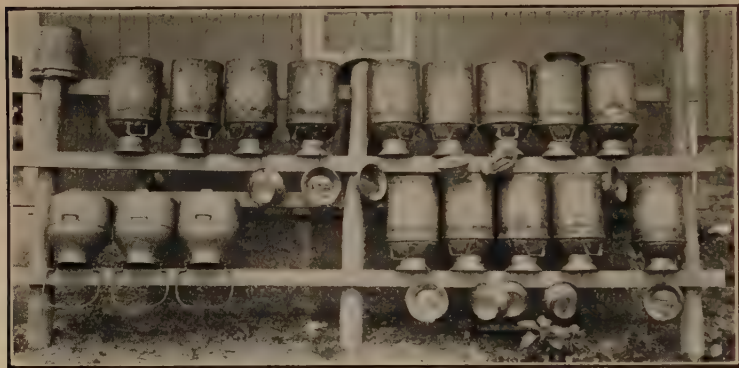


FIG. 46.—GIVING THE MILK CANS AND PAILS A SUN BATH

Experiments have shown that most of the bacteria in milk at the time the milking process is completed come from the pails, milking machines, strainers, cans, etc., used in handling the milk. Rapid drying, obtained by inverting the cans and pails on an outdoor rack at once after washing, is one of the most effective ways of keeping the germ content of milk low. Bacteria do not multiply rapidly in the absence of moisture, and direct sunlight is very effective in destroying them.

production of their milk and are able to obtain a higher price than that which prevails in the community. In such cases the milk is usually sold in bulk to restaurants, hotels, confectioners, etc.

Other dairymen are willing to invest in additional equipment and bottle and distribute their own milk. Such a method of disposing of milk increases the investment very materially, as well as the labor and other costs of production and marketing. When the business is properly managed, the increased selling price of the product more than equalizes the costs, and

the profits from the enterprise are larger than they otherwise would be. However, the demands upon the time and energy of the dairyman are much greater when milk is marketed in this way and a higher type of dairyman is required to make the business a success than if the milk is disposed of in the general market.

Certified milk is the best grade of milk sold and commands the highest price on the market. The demand for such a product is not large and is confined mostly to the larger cities. The expenses incident to the production of milk of this quality are high, and only a small number of select dairies would make a success of this type of market.

4. MARKETING CREAM FROM THE FARM

Most of the cream produced on our farms ultimately finds its way to the creamery or centralizer and is there made into butter. The greater part of such cream is sold as sour cream, though an increasingly large percentage is being sold as sweet cream ¹ at a slightly higher price. A relatively small percentage is marketed as sweet cream for special purposes.

Ways of marketing cream:

A. Sour cream.

B. Sweet cream.

A. Sour cream.—Cream sours as a result of the multiplication and activity of the lactic acid bacteria (generally *Bacterium lactis acidum*). When the culture of such bacteria is pure, the cream has a desirable flavor and produces a high quality of butter. There are other organisms, however, which are often found in cream and which injure the quality. Sour cream is marketed in all conditions and stages. Because of this fact, some creamery operators have attempted to grade cream and

¹ Sweet cream, as the name indicates, is marketed while still sweet; it is more desirable for most purposes and commands a higher price.

pay a higher price for the better grades. In fairness to both the farmer and the creamery operator, this should be done. If it were the common practice, dairymen generally would pay more attention to the quality of their product with the result that they would receive a better price and the quality of cream and butter in general would be greatly improved.

B. Sweet cream.—Cream that is marketed sweet for butter making is used for the making of a special grade of butter and returns a somewhat higher price than sour cream. Much of the sweet cream sold is used in the making of ice cream, in restaurants, hotels, etc. In such cases, also, the cream brings a higher price than if marketed sour. Such a special market, if it exists throughout the year, is satisfactory to the dairyman and leaves him his skim milk on the farm for livestock feeding.

5. MARKETING DAIRY PRODUCTS COOPERATIVELY

In this country, as in almost every other country, there is a growing interest in the cooperative marketing of dairy products. Such a system of marketing can be made extremely useful if based upon the proper principles. It is a fundamental principle that the agency which can render a given service in the most satisfactory manner and at the lowest cost will be the one selected, in the long run, to render that service. Cooperative marketing, as well as every other system of marketing, is subject to this general law; and for this reason those who desire to substitute a cooperative system for the one now in vogue should strive to improve the methods of marketing, establish definite grades and standards for products, increase the efficiency of transportation and distribution—in short, perform the marketing service better than it is now performed, or can be performed, by private agencies. When a system of cooperative marketing of dairy products is established in accordance with such standards it is likely that marketing in this way will become a more common practice.

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CHAPTER VIII

FILLING THE SILO

Filling a silo is a comparatively simple process when modern machinery and a sufficient supply of labor are available. A large amount of valuable feed may be harvested and stored in this way within a short time. When the corn is stored under good conditions, that is, when it is at the right stage of maturity, when the silo has air-tight walls, when the corn is properly packed, etc., a very appetizing and nutritious feed is produced. But when one or more of these conditions is not fulfilled, spoiling of the entire amount of feed may result. In order to secure good results, therefore, it is essential that one understand fully the necessary steps in filling the silo, as outlined below.

Operations:

1. Preparing the silo to receive the corn.
2. Determining when the corn is ready for harvest.
3. Arranging for equipment and labor for filling the silo.
4. Cutting the corn in the field.
5. Loading the corn on wagons.
6. Putting the corn through the silo filler.
7. Compacting the corn in the silo.
8. Making the doors air-tight.
9. Moistening the corn.
10. Refilling the silo.
11. Sealing the silo.
12. Avoiding carbon dioxide poisoning.

1. PREPARING THE SILO TO RECEIVE THE CORN

Leaks around the doors and through cracks in the walls frequently cause the spoiling of large amounts of silage. The silo itself may deteriorate rapidly if the walls are not given proper care. These matters should be given attention during spare time or on rainy days, a short time before the silo-filling season arrives.

Procedure:

- A. Sweep down walls.
- B. Clean floor or pit.
- C. Repair and fit doors.
- D. Tighten hoops.
- E. Treat walls if necessary.

A. Sweep down walls.—Brush down all chunks of dried silage, cobwebs, or other material adhering to the walls so that they will not become mixed with the fresh corn. Cleaning the walls will give a better opportunity to note their condition.

B. Clean floor or pit.—Remove all rotted silage and filth from the floor or pit of the silo. In case water has been allowed to stand in the pit, or from any cause there is a foul odor present, give the floor a thorough cleaning and then sprinkle 4 or 5 pounds of air-slaked lime in the pit. The lime acts as a disinfectant and in small quantities will not injure the cows.

C. Repair and fit doors.—Look over the doors to see that all are on hand, and repair those which are not in good shape. In case the doors do not fit tightly, secure a roll of light-weight roofing or heavy building paper. Cut this into pieces about 12 inches longer and wider than a door. Put these pieces in a dry place convenient to the silo so that they will be ready when the silo is being filled.

D. Tighten hoops.—Stave silos usually shrink in hot weather if they are empty. When the spaces between the staves become quite wide, that is, a quarter of an inch or more, or when day-

light can be seen between the staves, the hoops should be tightened before the silo is filled.

To tighten the hoops, use a large wrench and begin either at the top or bottom of the silo. Tighten both burrs at one joint a little, and then proceed around the silo and tighten about the same amount the burrs at the other joints of the same hoop. Each hoop usually consists of two or three sections. Do not attempt to tighten one hoop by tightening one joint alone, as this does not draw the staves together evenly. Also, do not tighten the burrs as much as is possible, for as soon as the silo is filled, the staves will begin to swell, and thus become tighter.

Try to tighten all hoops uniformly. It is usually possible to take up the hoops at the middle of the silo much more than at top or bottom, but this should not be done for it would cause the silo to become misshapen and air pockets to form along the walls when the silage settles.

E. Treat walls if necessary.—The walls of silos are subject to the action of the acid and moisture of the silage. In concrete silos, the action of the acid destroys some of the cement, making the walls porous. The moisture of silage tends to cause rotting of wood silos.

The inside walls of concrete silos may be given a cement wash every two or three years, or they may be treated with a coal-tar preparation sold for this purpose by coal-gas companies. The treatment with tar usually is the more lasting in its effect. The tar treatment is also suitable for other types of silos. Concrete, tile, brick, or wood silos may also be treated with melted paraffine. Both the tar and the paraffine are applied hot by means of a wide brush. The cement wash is prepared by mixing cement and water to the consistency of a thick cream.

Any of these treatments is most easily applied as the silo is being emptied, provided it can be done when the temperature is above freezing. Each time the silage has been lowered 10 or 12 feet, the treatment may be applied to the emptied part. A short ladder is then all that is needed to reach the walls. The silage should be protected by covering it completely with gunny

sacks or canvas. If the treatment is done while the silo is empty, a circular platform, fitting loosely inside the silo, can be arranged to be raised or lowered by means of blocks and tackle fastened to the roof of the silo.

2. DETERMINING WHEN THE CORN IS READY FOR HARVEST

The keeping qualities of the silage, as well as its nutritive value, are to a large extent dependent upon the stage of maturity of the corn at the time it is put into the silo. It is, therefore, important to ensile the corn as nearly at the best stage as possible.

Procedure:

- A. Make frequent examinations of corn in field.
- B. Learn dates of killing frosts.

A. Make frequent examinations of corn in field.—As soon as the ears of the corn show well-filled kernels, examine the corn every few days in order to follow its development. When corn approaches the ripening stage, two or three days of hot weather usually make a great change in the moisture content of the plant and the ripeness of the ears. Therefore, follow the changes carefully so that plans for filling the silo can be made several days in advance.

It is best to allow the corn to become as ripe as possible while still retaining green leaves and a large amount of water in the stalks. Silage made from corn that is a little too green, however, will be better than that made from corn that is too ripe. Dent varieties of corn, grown in regions where the grain usually matures, are ready for the silo when two-thirds of the ears have well-dented kernels, but it usually does no harm to allow nearly all the ears to become well dented, provided the leaves are still green. Flint varieties or those varieties which mature early should be ensiled when the grain begins to harden, but while most of the leaves are still green.

B. Learn dates of killing frosts.—In northern states, the time of filling silos is largely governed by the approach of frosts that threaten to kill the corn. The same is true whenever large late varieties are grown for silage in regions where they do not mature the grain. In such cases particularly, and also in



FIG. 47.—EARS OF CORN AT DIFFERENT STAGES OF DEVELOPMENT

The ear at the left is too immature for good silage, and that at the right is too mature. The best stage of development for silage is when the majority of the ears are as far advanced as the second ear from the left and no more mature than the second from the right.

all cases where corn is grown for silage, the dates of killing frosts should be learned and a record kept for reference.

Obtain these dates from someone in the neighborhood who has kept them, or write to the nearest Government Weather Bureau station located in the same latitude as your farm. The location of such a station may be obtained by consulting

a newspaper that publishes full daily weather reports or by writing the Weather Bureau, U. S. Dept. of Agriculture, Washington, D. C.

3. ARRANGING FOR EQUIPMENT AND LABOR FOR FILLING THE SILO

The work of filling the silo can be performed more easily and effectively if the necessary arrangements are made beforehand.

Procedure:

- A. Arrange early for filling outfit, men, and teams.
- B. Provide a full crew.

A. Arrange early for filling outfit, men, and teams.—Some weeks before the silo-filling season begins, make arrangements to hire or purchase a silo-filling outfit, in case one is not owned on your farm. If your work is being done independently, make preliminary arrangements early in the summer for your help. Final arrangements can then be quickly made a few days in advance of the filling date. In many dairy sections, silo-filling work is exchanged by the farmers of a neighborhood, just as in threshing, one filling outfit being used for all the silos belonging to that group.

B. Provide a full crew.—The amount of help required to operate a modern filling outfit, which handles 75 to 100 tons of corn a day, is about as follows: Two men to operate tractor and corn harvester or two horse-drawn corn harvesters for cutting the corn in the field; three or four men to load corn on wagons; six to eight men and teams to haul the corn to the filler; two men to operate gas-power filling outfit, or three men with steam-power outfit; two or three men to level and tramp the cut corn in the silo. This will mean a total of fifteen to twenty men.

4. CUTTING THE CORN IN THE FIELD

Several different machines for harvesting corn are used. The most common is the corn harvester, which cuts the corn, binds it into bundles, and drops them on the ground singly or in lots of three or four. Some harvesters have an elevator attachment which elevates the bundles on to a wagon driven alongside the harvester. Another type, termed the sled stype, consists of a



FIG. 48.—CUTTING CORN FOR SILAGE

Corn is the leading silage crop, yielding a large amount of digestible matter per acre and producing a palatable and nutritious feed. In sections where it can be grown to advantage, it forms a relatively cheap feed.

low-hung V-shaped platform having stationary knives attached to its edges. While this is being drawn between two rows of corn by one horse, two men gather the corn in their arms.

When corn is badly lodged and twisted it is sometimes cut by hand, although this is usually an expensive procedure. Hand cutting is often resorted to in removing the outside rows of the field before starting the harvester, in order to save these rows from being broken down.

Procedure:

- A. Start cutting at least half a day in advance of hauling.
- B. Divide field into sections.
- C. Bind corn into medium-sized bundles.

A. Start cutting at least half a day in advance of hauling.—Start cutting the corn in the field half a day or more before filling



FIG. 49.—CUTTING AND LOADING CORN FOR SILAGE IN ONE OPERATION

A wagon is driven alongside the corn harvester and receives the bundles as they fall from the elevator attachment.

is to begin. Determine the amount needed to be cut in advance, by observing the practice followed by your neighbors who have employed the same filling outfit.

B. Divide field into sections.—In harvesting silage corn, divide large fields into smaller sections, or lands, of 5, or not

more than 10, acres. It is usually necessary to cut in two directions only, driving the machine empty across the ends of the sections.

C. Bind corn into medium-sized bundles.—Do not make the bundles as large as possible. Medium-sized bundles do not tire the men so quickly and are fed more easily into the filling machine.

5. LOADING THE CORN ON WAGONS

As intimated above, the bundles are elevated to the wagons by the corn harvester or by hand labor. In some cases the teamster loads his own wagon, a low rack or wagon usually being used in this case; or special men hand up the bundles to the teamster on the wagon. In any case, the same precautions in loading the wagons should be followed, as outlined below:

Procedure:

- A. Begin loading wagon at rear end.
- B. Place butts of bundles all in one direction.
- C. Avoid walking on bundles after loading.

A. Begin loading wagon at rear end.—Begin the load by piling the bundles crosswise of the rack at the rear end. Keep the bundles as straight as possible so that they will not become tangled. Build up a pile against the rear standard of the rack covering a space about 3 feet of the length of the rack, and as high as possible without the bundles rolling down. Then build up from the bottom again with one or two bundles as a foundation. Continue in this way until the wagon is loaded.

B. Place butts of bundles all in one direction.—In loading the wagon, place the bundles so that they all lie in the same direction, that is, with the butts all at one side of the rack. The reasons for this are, first, ease in unloading, and second, ease in

feeding into the silo filler as all bundles are placed in either heads first or butts first, usually the latter.

Whether the butts of the bundles should be placed at the right or the left side of the rack will depend upon the position of the wagon when it is driven up to the filler.

C. Avoid walking on bundles after loading.—One of the chief objects in loading the wagon at the rear end first is to save



FIG. 50.—LOADING CORN THAT IS TO BE PUT INTO THE SILO

When corn is nearly ripe, and the weather dry, it should be ensiled soon after it is cut, for wilting and loss of moisture occur rapidly if it is allowed to lie on the ground under such conditions.

tangling of the bundles by walking on them. In loading and unloading, always stand on the rack and do not walk on the bundles. In finishing the load at the front end, stand at one side of the rack. Do not walk over the bundles after the wagon is loaded.

Begin unloading at the front end of the wagon, removing first the bundles that were loaded last.

6. PUTTING THE CORN THROUGH THE SILO FILLER

The following directions will be found helpful in using the silo filler.

Procedure:

- A. Unload bundles butts first.
- B. Cut bands, if necessary.
- C. Cut corn into short lengths.
- D. Keep knives sharp.

A. Unload bundles butts first.—Unless the bundles are badly misshapen, they are more easily handled in unloading and are



FIG. 51.—PUTTING CORN THROUGH A SILO FILLER

The bundles are being unloaded butt end first, in accordance with the usual practice. The silo in this case is built of wood staves.

fed into the filler better when unloaded butt first. The bundles should be unloaded one by one, at such a rate of speed that each bundle laps the preceding one by about one-third of its length. This arrangement makes a uniform pull on the belt, and keeps the filler working at its maximum capacity. It is

sometimes necessary to have two men to unload one wagon in order to unload this rapidly, but this is generally more satisfactory than to try to unload from two wagons at once.

The unloading must be done more slowly, of course, in case the power is insufficient or a small silo-filling machine is used.

B. Cut bands, if necessary.—It is not necessary to cut the bands when the bundles are of medium size and a large filling machine is used. If the machine is small or if the bundles are very large, cut the bands and spread the bundles a little as they enter the throat of the machine.

C. Cut corn into short lengths.—Set the machine so that it will cut the corn into pieces one-half to three-fourths of an inch long. This makes it possible to pack the corn more closely in the silo.

D. Keep knives sharp.—Be sure that the knives are kept sharp; for as soon as they become dull, husks may go through the machine uncut, making close packing difficult. Also, more power is required when the knives are dull. The knives dull more quickly when the corn is quite ripe and dry.

It is best to have two or more sets of knives so that one can be sharpened while the other is in use. Usually the knives should be changed after each half day's run.

7. COMPACTING THE CORN IN THE SILO

It is important that the corn be packed solidly and evenly in the silo. This can be accomplished by the methods described below.

Procedure:

- A. Spread cut corn by means of a distributor pipe.
- B. Tramp corn thoroughly.

A. Spread cut corn by means of a distributor pipe.—A sectional distributor pipe attached to the end of the blower pipe

is the best means for spreading the corn in the silo. This should be long enough to permit the man operating it to reach it easily. In using the distributor, start at the side of the silo farthest from the point where the pipe enters. Move the pipe from side to side, making a layer of corn 6 to 8 inches deep. Walk backwards as the surface is covered.

B. Tramp corn thoroughly.—Tramp the corn as it comes into the silo, since this helps to exclude the air, especially if the corn is somewhat dry. The corn next to the wall of the silo must be tramped more than that in other parts, because the friction of the walls tends to prevent settling.

8. MAKING THE DOORS AIR-TIGHT

All necessary precautions should be taken to exclude air from the silo.

Procedure:

A. Put doors in place as needed.

B. Cover, with building paper, any doors that do not fit tightly.

A. Put doors in place as needed.—If the doors have been overhauled and put in good repair as directed in Section 1 of this chapter, there should be no difficulty in getting them to fit. Put the doors in place as the silo is filled. For the sake of ventilation, not more than one or two doors should be fitted in above the level of the silage at any time.

B. Cover, with building paper, any doors that do not fit tightly.—In case the felt strips on the edges of the doors or door frame are not in good condition or not in place, first fasten the door and then cover it with a piece of building paper or roofing material previously made ready. Place this sheet over the door so that it extends 6 inches or more beyond the edges

of the door on all sides. Drive a tack through each of the upper corners or throw a few forkfuls of silage against it to hold it in



FIG. 52.—FILLING A LARGE SILO

Much labor in hauling is saved when the corn field is located near the silo.

place. Be sure that no silage gets between this sheet and the door or wall.

9. MOISTENING THE CORN

A much greater yield of nutrients per acre is secured if the corn is allowed to ripen before cutting, and the feeding value per pound is also greater than if the corn were cut at an immature stage. For this reason there has been a tendency during past years to put corn in the silo so ripe that it did not pack well. Air pockets are thus left, and mold forms all through the silage. This difficulty is overcome by ensiling the corn while it still has sufficient moisture, or if this is not possible, by adding water during the filling process. In moistening the corn the following directions should be followed.

Procedure:

- A. Determine dry-matter content of corn.
- B. Decide whether water should be added.
- C. Calculate amount of water necessary.
- D. Add water as required.

Equipment:

Corn knife, scoop shovel, pail, scales, large pans, stove, pressure water supply or portable water tank, hose.

A. Determine dry-matter content of corn.—If there is serious doubt that the corn to be put in the silo has sufficient water to produce good silage, make a determination of its water and dry-matter content.

Before securing the corn, make ready the equipment to be used in weighing and drying the sample. Be sure that a sensitive scale is available. A good circular spring balance milk scale which weighs to one-tenth pound or smaller division, or a small kitchen scale equally sensitive, may be used. Secure as many iron or tin baking pans as can be placed in the oven of a kitchen range.

Line the bottom and sides of each pan with heavy wrapping paper. This prevents the corn from sticking to the pan and keeps the pan clean. A range using coal, wood, or gas is suit-

able. Light the fire before weighing out the corn, so that the oven will be warming.

The determination can be made before the cutting of corn for the silo is begun, but is more readily carried out by sampling the first one or two loads of corn as they are being put into the silo. If standing corn is to be used, select twelve to fifteen stalks representing as nearly as possible the condition of the corn in the field. Cut at the usual height. Run the stalks through a hand or power cutter, cutting them into 1-inch lengths or shorter. If such a cutter is not available, cut into equally small pieces by using a sharp corn knife. By means of a scoop shovel, mix the cut corn thoroughly and weigh out a sample for drying as directed below.

When selecting the cut corn from the silo, take large handfuls at a number of different points in the silo and collect them in a pail. If the loads of corn seem to differ in dryness, select a pailful of corn from each of several loads. Empty the cut corn on to a clean floor and mix thoroughly by means of a shovel.

Weigh the empty paper-lined pans. Then weigh out a 3- or 4-pound sample, depending upon the size of the oven to be used, and place in the pans, spreading as thinly as possible, so that it no more than covers the bottom of the pans. A large sample is preferable, as the error is less. Place the pans in the oven and note the hour.

Keep a "moderate" heat for a time. If the stove is equipped with an oven thermometer or a gas regulator, try to keep the temperature at about 125° C., or 250° F. Examine the corn every half hour and stir it in the pans, being careful not to spill or lose any. The corn may turn slightly brown in drying, but this will do no harm. It must not be allowed to char, however, as this will result in a loss of dry matter. If it begins to turn black or burn, reduce the heat at once. When it is not possible to lessen the fire, leave the oven door partly open until the oven cools sufficiently. Stir the corn in any pan that shows signs of charring, and place this pan in the coolest part of the oven.

At the end of one and one-half hours remove the pans from the oven and weigh them. Record the weight. Stir the corn and replace the pans in the oven. Weigh again at the end of two hours. If the weight is less than at the previous weighing, heat again for fifteen to thirty-minute periods until the weight remains the same. Determine the weight of the dried corn and its percentage of dry matter.

Example: A 4-pound sample of corn silage was put into the oven at 5:15 o'clock. At 7:45 and at 8:15 o'clock the weight was $1\frac{5}{16}$ pounds. $1\frac{5}{16} = 1.312$. The percentage of dry matter would be $\frac{1.312}{4} \times 100 = 32.8$. The decimal in the result can be disregarded, and 33 used as the percentage of dry matter in the sample. The percentage of moisture would then be $100 - 33 = 67$.

B. Decide whether water should be added.—Corn having a dry-matter content ranging from 25 per cent to 35 per cent makes the best-quality silage, although corn having as little as 20 per cent dry matter or as much as 40 per cent often keeps well. If your determination shows the dry-matter content of the corn to be close to or greater than the limit of 40 per cent, it is advisable to add water.

If the dry-matter content is less than 20 per cent, the corn may be allowed to mature more fully before harvesting, provided the season permits, or it may be left on the ground after harvesting until it has wilted sufficiently for the dry-matter content to exceed 20 per cent.

C. Calculate amount of water necessary.—Table VIII shows the amount of water necessary to be added to corn which is too dry to make good silage. The figures may be applied to corn being ensiled at once after harvesting and also to corn stover being ensiled.

In order to add the water in the correct amounts, it is necessary to know the weight of the loads of corn. In case a wagon scale is not available, the weights of the loads can be estimated as follows:



FIG. 53.—SOYBEANS IN CORN FOR SILAGE

Soybeans are sometimes planted with corn for silage, in order to increase the protein content of the silage.

Weigh half a dozen or more representative bundles of corn by means of a spring dial scale, and calculate the average weight. As several different drivers unload the corn from their wagons, count the number of bundles being thrown into the silo filler. Note whether some wagons are much larger than others. Calculate the average weight per load, using the figures obtained.

TABLE VIII

AMOUNTS OF WATER TO BE ADDED TO CORN BEING ENSILED IN ORDER TO MAKE GOOD SILAGE *

Dry-Matter Content of Corn	Amount of Water to Be Added to Each Ton of Corn Ensiled		
	Cubic feet	Gallons	Pounds
25	00	00	00
30	00	00	00
35	00	00	00
40	10.6	80	666
45	16.0	120	1000
50	21.3	160	1333
55	26.7	200	1666
60	32.0	240	2000
65	37.3	280	2333
70	42.7	320	2666
75	48.0	360	3000
80	53.3	400	3333

* These figures apply to corn stover being ensiled as well as to corn freshly cut.

NOTE.—One cubic foot of water weighs 62.5 pounds, and one gallon weighs 8.32 pounds.

D. Add water as required.—The best way to add the water to the corn is through the flexible distributor pipe by means of a pressure system. The water is forced through a hose the end of which is inserted into the upper end of the distributor pipe. With such a system, the water is easily measured by means of a

meter, such as is used in dwellings supplied by a city water system. Such meters cost about \$15 each.

Most farms, however, do not have pressure water systems and other means must be employed. A practicable method is to fill a portable water tank, such as is used with steam threshing outfits and place it beside the silo filler. The water is siphoned from the tank by means of a large rubber hose, the lower end of which is fastened in a position to discharge into the blower of the silo filler. Adjust the rate of flow so that the water is added at the correct rate as the corn goes through the filling machine. Whenever corn is not being put into the machine, shut off the water.

The addition of water to the corn after the silo has been filled rarely proves satisfactory, since the water seeps down next the walls of the silo and seldom penetrates to the center of the silage. Water added through the blower or distributor, as the silo is being filled, becomes thoroughly mixed with the corn and aids in preservation.

The capacity in cubic feet of a rectangular tank may be calculated by multiplying together the numbers representing the length, width, and depth in feet.

The capacity of a cylindrical tank in cubic feet may be calculated by multiplying together the numbers representing the length or height, one-half the diameter squared, and 3.1416.

10. REFILLING THE SILO

Refilling is seldom practicable where one large commercial outfit is used for filling a large number of silos, but is often done where a small group of neighbors own a filling outfit jointly.

Procedure:

- A. Allow silage to settle for a few days.
- B. Prevent spoilage by feeding.
- C. Fill silo as before.

A. Allow silage to settle for a few days.—A silo can be made to hold much more if the corn is allowed to settle for three or four days after filling and the silo is then filled again. The corn usually settles 10 per cent or more of the height to which the silo was filled.

B. Prevent spoilage by feeding.—When it is planned to refill, the silage at the surface can be kept from spoiling by removing for feeding a 2-inch layer each day, beginning at once after filling ceases. In case the silage at the surface becomes spoiled, discard the spoiled portion before refilling begins.

C. Fill silo as before.—Fill the silo as before, observing the precautions given above with respect to sufficient moisture, compacting the corn, etc.

11. SEALING THE SILO

Silage that is exposed to the air for several days becomes moldy or decayed and is unfit for feeding. Some of the loss which usually occurs at the surface of the silo, when feeding is not begun at once after filling, can be prevented by simple expedients.

Procedure:

- A. Remove ears from last loads of corn.
- B. Tramp surface thoroughly.
- C. Seal surface.

A. Remove ears from last loads of corn.—If feeding is not begun at once after the filling of the silo, it is usually impossible to prevent entirely the spoiling of the top layer of silage, which means that some of the silage must be discarded when the feeding season begins. When corn bearing fairly mature ears that can be used for feeding or put in the crib is being used for the silo, some loss in spoilage may be avoided by removing the ears from the last two or more loads, which go to make up the top layer in the silo.

B. Tramp surface thoroughly.—Tramp very thoroughly the last few loads of corn being put into the silo. The next day and about every other day for a week or ten days, tramp it again, at the same time wetting it thoroughly by means of a hose. The water helps to pack the corn and exclude the air. However, the tramping should be done even if it is impossible to get water up into the silo. Thorough tramping reduces the amount of spoiled silage.



FIG. 54.—CUTTING SUNFLOWERS FOR SILAGE

The sunflowers illustrated here yielded nearly 20 tons per acre. Sunflower silage is less palatable than corn silage, but makes a satisfactory substitute where corn can not be grown.

C. Seal surface.—Several different plans for sealing the surface of the silo are in use. Most of these materially reduce spoiling of the silage, and some prevent it.

Covering with grass or weeds is quite effective. To cover in this way, run two or more loads of green grass or weeds through the silo filler immediately after the last load of corn. To be of any value, the grass or weeds must be high in water content or water must be added, so that the cut material will pack well in the silo.

A circular waterproofed canvas cover is sometimes used, the middle just covering the silage and the sides extending up about 2 feet against the wall of the silo. After the canvas is spread, it is filled with water to a depth of at least 8 or 10 inches. The weight and side pressure of the water prevents air getting between the canvas and the silage.

Seeding the surface thickly with oats is also employed. The moisture and warmth cause the oats to sprout quickly, and they form a dense mat of roots which helps to keep out the air.

In the case of pit silos or those extending but a short distance above the ground, the surface of the silage is sometimes covered with a quantity of soil sufficient to weight it down well. Such a cover proves very effective.

12. AVOIDING CARBON DIOXIDE POISONING

Carbon dioxide gas is produced by the fermentation of corn in the silo. The gas is colorless and odorless and causes death quickly if inhaled in large quantities. It is heavier than air and collects above the silage in pit silos or in silos in which the doors are kept closed without good ventilation. The following precautions should be observed during the filling process and for a few weeks following:

Procedure:

- A. Start blower before entering silo.
- B. Leave doors that are not in use open during filling process.
- C. In doubtful cases, test for presence of gas before entering silo.

A. Start blower before entering silo.—There is no danger of carbon dioxide collecting in a silo when there is good circulation of the air caused by wind blowing into the silo or by the blowing of the cut corn into the silo during filling. The gas is likely to collect during the night or when the silo is kept closed for a day

or two between fillings. Therefore, if there is any chance for carbon dioxide to collect, run the silo-filling machine for a few minutes before entering the silo so that the blower will cause a circulation of the air.

B. Leave doors that are not in use open during filling process.—Put the doors of the silo in place as they are needed to retain the cut corn, leaving the ones above these open for ventilation.

C. In doubtful cases, test for presence of gas before entering silo.—If there is any reason for suspecting the presence of unusual amounts of carbon dioxide gas in the silo, lower a lighted lantern or candle to the bottom. If the flame goes out, it is very likely that carbon dioxide is present. Do not enter the silo until it has been thoroughly ventilated and another test shows that it is safe.

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COMMUNITY STUDIES

Visit a number of farms having silos and observe the practices followed in caring for the silos and in filling them. Make the visits at the time the silos are being filled, and later when the silage from the same silos is being fed.

1. What is the construction of the silos?
2. What care is given the silo to keep it in good repair?
3. Is any special care given the silo just before filling?
4. At what stage of maturity is the corn cut for silage?
5. How many men and teams are used in filling the silo?
6. Do teamsters load their own wagons?
7. How far is it from the field to the silo?
8. How many loads of corn are ensiled daily?
9. How many men are used in unloading? In operating the filling outfit?
10. Are bundles fed into the machine tassels first or butts first?
11. Are the bands cut before the bundles are fed into the machine?
12. What is the length into which the corn is cut?
13. Is water added during the filling of the silo, and if so, how and at what rate?
14. Is a flexible distributor pipe used in filling the silo?
15. Is the silage tramped thoroughly?
16. What precautions are taken to make the doors fit tightly?
17. Is the silo refilled? If so, how much corn is put in at refilling?
18. What methods are used to seal the silo?
19. How soon after filling is feeding begun?
20. Is any moldy silage found in the silos which you saw filled?
21. Can you account for the presence of mold on the basis of lack of sufficient moisture, insufficient tramping, or leaks through walls or around doors?
22. Does silage have a strong acid odor and taste?
23. In the case of silage showing a high acid content, what was the stage of maturity of the corn at the time of filling the silo?
24. Can any preference of the cattle for silage made from corn ensiled at different stages of maturity be noted?
25. Are crops other than corn used for silage and with what success?

CHAPTER IX

FEEDING THE DAIRY COW DURING THE WINTER SEASON

The feeding of dairy cows during the winter season offers more problems than the feeding of cows on pasture, chiefly on account of the greater cost of the feed and the variety of feeds that are usually necessary.

Operations:

1. Selecting feeds for the ration.
2. Balancing the ration.
3. Grinding feed.
4. Mixing feed.
5. Feeding silage.
6. Feeding concentrates.
7. Feeding hay.
8. Feeding dry roughage other than hay.
9. Feeding roots or pumpkins.
10. Feeding dry cows.
11. Feeding after freshening.
12. Feeding mineral supplements.
13. Insuring a supply of vitamins.

1. SELECTING FEEDS FOR THE RATION

There are great differences between feeds with respect to their value for milk production, as well as in their market prices. Large opportunity to exercise good judgment and business ability is presented in the selection of the most desirable feeds.

Procedure:

- A. Make inventory of feeds on hand.
- B. Learn kinds and prices of feeds at local market.
- C. Select most desirable feeds from standpoint of digestibility, physiological effect, etc.
- D. Choose two or more rations that meet your conditions.
- E. Select feeds from standpoint of economy of the nutrients.
- F. Compute amount of feed needed.
- G. Purchase feed needed.

A. Make inventory of feeds on hand.—Examine the stocks of feed on hand in grain bins, corn crib, hay mow, silo, etc., and estimate the number of bushels of grain, pounds of mill feed, and tons of hay and silage on hand, recording each item in a notebook. (See Tables XX and XXI of the Appendix for method of calculating capacity of hay mows, silos, and bins.)

B. Learn kinds and prices of feeds at local market.—Visit your local feed store or elevator and learn the prices of all the feeds you have listed as being on hand. Also inquire what other feeds the local dealer has for sale and their prices. Make a list of all these prices in your notebook. In case you cannot learn from your local dealer the prices of feeds on hand at your farm, consult a farm paper or newspaper giving market quotations.

C. Select most desirable feeds from standpoint of digestibility, physiological effect, etc.—Read the discussion of the qualities of an ideal ration as given under general information at the end of this chapter, and study the information given in Table XXII. Make a list of the feeds on hand which seem to be desirable for use in the ration. If there are any feeds on hand which do not seem desirable, put them in a separate list. Now add to the list of desirable feeds those which the local dealer carries which also seem well suited for a good dairy ration.

D. Choose two or more rations that meet your conditions.—

Consult the feeding charts as given in Table IX, and select two or more rations from the list suggested for use under the conditions of breed of cattle, kinds of roughages, etc., on your farm. It is best to choose the rations that contain, so far as possible, the kinds of feeds you have on hand.

E. Select feeds from standpoint of economy of nutrients.—

It is generally found more economical to use the feeds produced on the farm than to sell them and purchase others in their

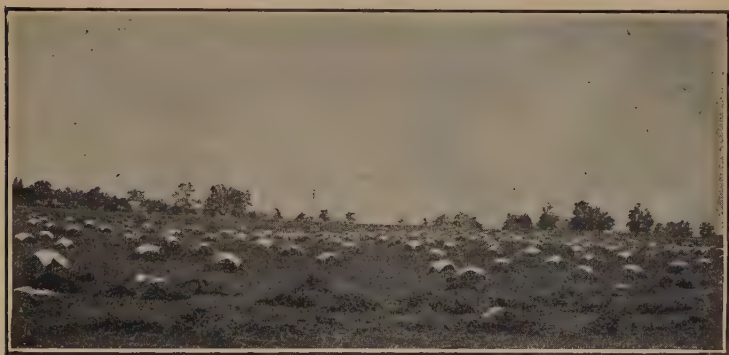


FIG. 55.—ALFALFA HAY UNDER CAPS

Curing alfalfa by putting it into shocks as soon after cutting as it becomes well wilted helps to retain the leaves and color and produces a better quality of hay than curing in the swath or windrow. Caps made of muslin, with weights at the corners, are sometimes used to protect the shocks from rain. This method of curing produces a superior quality of hay, since it assists in retaining the vitamins, but is not widely used on account of the large amount of labor involved.

places. This may not be true, however, if the roughages on hand consist only of non-legume hay, such as timothy or redtop. If the non-legume hay can be marketed and good legume hay purchased in its place at about the same price per ton, it is usually a paying transaction to make the exchange. The labor involved in the transaction must be considered as one of the deciding factors as to whether the exchange should be made. In case it does not seem feasible to exchange all the non-legume hay for legume hay, there may be an advantage in exchanging

about one-half of the hay, so that at least one feed of legume hay may be given daily. Such an arrangement very greatly improves the ration as compared with straight non-legume feeding.

TABLE IX

CONCENTRATE MIXTURES FOR DAIRY COWS WITH DIRECTIONS FOR
FEEDING THEM *

MIXTURES FOR HOLSTEINS, BROWN SWISS, AND AYRSHIRES

I. When roughage is partly legume and partly non-legume

(Combinations of alfalfa, clover, soybean or cowpea hay with timothy, millet, redtop, oat, bluegrass or prairie hays, corn stover or corn silage. It is assumed that if dry roughage only is fed, at least one-half of it is legume hay. If corn silage is given, two feeds of legume hay daily are allowed.)

When milk yield is 10 to 25 pounds daily, feed 1 pound of one of the following grain mixtures for each 4 pounds of milk produced, or $2\frac{1}{2}$ pounds of mixture for each gallon of milk.

When milk yield is more than 25 pounds daily, feed 1 pound of one of the following mixtures for each $3\frac{1}{2}$ pounds of milk produced, or $2\frac{1}{2}$ pounds of the mixture for each gallon of milk.

No. 1	No. 2
333 lbs. wheat bran	100 lbs. soybean oil meal
333 lbs. ground corn	450 lbs. ground corn
324 lbs. ground oats	440 lbs. ground oats
10 lbs. salt	10 lbs. salt
1 qt. of mixture weighs $\frac{3}{4}$ lb.	1 qt. of mixture weighs 1 lb
No. 3	No. 4
450 lbs. ground barley	100 lbs. cottonseed meal, choice
75 lbs. linseed oil meal or ground soybeans	200 lbs. ground velvet beans or 75 lbs. soybeans
465 lbs. ground oats	690 lbs. hominy feed
10 lbs. salt	10 lbs. salt
1 qt. of mixture weighs $\frac{7}{8}$ lb.	1 qt. of mixture weighs 1.5 lbs.

* Adapted from Ill. Agr. Exp. Sta. Cir. 272, Feeding and Management of the Dairy Herd, by W. B. Nevins.

TABLE IX—*Continued***No. 5**

100 lbs. gluten feed
 100 lbs. corn germ meal
 100 lbs. std. middlings
 100 lbs. dried beet pulp
 300 lbs. ground oats
 290 lbs. hominy feed
 10 lbs. salt

1 qt. of mixture weighs 1 lb.

No. 6

740 lbs. ground kafir
 100 lbs. wheat bran
 100 lbs. std. middlings
 50 lbs. cottonseed meal, choice
 10 lbs. salt.

1 qt. of mixture weighs 1.2 lbs.

II. When roughage consists of legumes only

(Alfalfa, clover, soybean or cowpea hay; that is, when no silage, corn stover, or hay other than those mentioned is fed.)

Feed 1 pound of one of the following grain mixtures for each 2½ pounds of milk produced, or 3½ pounds for each gallon of milk.

No. 7

200 lbs. wheat bran
 400 lbs. ground corn
 390 lbs. ground oats
 10 lbs. salt

1 qt. of mixture weighs 0.8 lb.

No. 8

100 lbs. soybean oil meal or
 ground soybeans
 500 lbs. ground corn
 390 lbs. ground oats
 10 lbs. salt

1 qt. of mixture weighs 1 lb.

No. 9

500 lbs. ground barley
 50 lbs. linseed oil meal or ground
 soybeans
 440 lbs. ground oats
 10 lbs. salt

1 qt. of mixture weighs 1 lb.

No. 10

100 lbs. cottonseed meal, choice
 100 lbs. ground velvet beans
 790 lbs. hominy feed
 10 lbs. salt

1 qt. of mixture weighs 1.4 lb.

No. 11

100 lbs. gluten feed
 100 lbs. corn germ meal
 100 lbs. std. middlings
 200 lbs. dried beet pulp
 190 lbs. ground oats
 300 lbs. hominy feed
 10 lbs. salt

1 qt. of mixture weighs 1 lb.

No. 12

790 lbs. ground kafir
 100 lbs. wheat bran
 100 lbs. std. middlings
 10 lbs. salt

1 qt. of mixture weighs 1 lb.

TABLE IX—*Continued***III. When roughage is all non-legume**

(Timothy, millet, redtop, oat, bluegrass, or prairie hays, corn stover, corn silage, or combinations of these.)

When milk yield is 1 to 25 pounds daily, feed 1 pound of one of the following grain mixtures for each 4 pounds of milk produced, or $2\frac{1}{2}$ pounds of the mixture for each gallon of milk.

When milk yield is 26 to 35 pounds daily, feed 1 pound of one of the following grain mixtures for each 3 pounds of milk produced, or $2\frac{1}{3}$ pounds of the mixture for each gallon of milk.

When milk yield is more than 35 pounds daily, feed 1 pound of one of the following mixtures for each $2\frac{1}{2}$ pounds of milk produced, or $3\frac{1}{2}$ pounds of the mixture for each gallon of milk.

No. 13

200 lbs. wheat bran
400 lbs. linseed oil meal
200 lbs. ground corn
170 lbs. ground oats
20 lbs. ground limestone
10 lbs. salt
1 qt. of mixture weighs 0.9 lb.

No. 15

300 lbs. ground barley
300 lbs. ground soybeans or linseed oil meal
200 lbs. gluten meal
170 lbs. ground oats
20 lbs. ground limestone
10 lbs. salt.
1 qt. of mixture weighs 1.3 lbs.

No. 17

100 lbs. gluten feed
100 lbs. corn germ meal
200 lbs. wheat bran
100 lbs. std. middlings
100 lbs. ground oats
100 lbs. hominy feed
100 lbs. soybean oil meal
170 lbs. gluten meal
20 lbs. ground limestone
10 lbs. salt
1 qt. of mixture weighs 1 lb.

No. 14

350 lbs. soybean oil meal
350 lbs. ground corn
270 lbs. ground oats
20 lbs. ground limestone
10 lbs. salt
1 qt. of mixture weighs 1.1 lbs.

No. 16

200 lbs. cottonseed meal, choice
200 lbs. ground velvet beans
200 lbs. ground soybeans
370 lbs. hominy feed
20 lbs. ground limestone
10 lbs. salt
1 qt. of mixture weighs 1.5 lbs

No. 18

170 lbs. ground kafir
400 lbs. wheat bran
200 lbs. std. middlings
200 lbs. cottonseed meal, choice
20 lbs. ground limestone
10 lbs. salt
1 qt. of mixture weighs 0.9 lb.

TABLE IX—*Continued*

MIXTURES FOR JERSEYS AND GUERNSEYS

I. When roughage is partly legume and partly non-legume

(Combinations of alfalfa, clover, soybean, or cowpea hay with timothy, millet, redtop, oat, bluegrass, or prairie hays, corn stover or corn silage. It is assumed that if dry roughage only is fed, legume hay forms at least one-half of it. If corn silage is given, two feeds of legume hay daily are allowed.)

When milk yield is 5 to 25 pounds daily, feed 1 pound of one of the following grain mixtures for each 3 pounds of milk produced, or $2\frac{7}{8}$ pounds of the mixture for each gallon of milk.

When milk yield is more than 25 pounds daily, feed 1 pound of one of the following grain mixtures for each $2\frac{1}{2}$ pounds of milk produced, or $3\frac{1}{2}$ pounds of the mixture for each gallon of milk.

No. 19

600 lbs. wheat bran
200 lbs. ground corn
190 lbs. ground oats
10 lbs. salt

1 qt. of mixture weighs $\frac{2}{3}$ lb.

No. 21

440 lbs. ground barley
150 lbs. linseed oil meal or ground
soybeans
400 lbs. ground oats
10 lbs. salt

1 qt. of mixture weighs 1 lb.

No. 23

200 lbs. gluten feed
100 lbs. corn germ meal
100 lbs. std. middlings
100 lbs. dried beet pulp
300 lbs. ground oats
190 lbs. hominy feed
10 lbs. salt

1 qt. of mixture weighs 1 lb.

No. 20

125 lbs. soybean oil meal
400 lbs. ground corn
465 lbs. ground oats
10 lbs. salt

1 qt. of mixture weighs 1 lb.

No. 22

150 lbs. cottonseed meal, choice
200 lbs. ground velvet beans
640 lbs. hominy feed
10 lbs. salt

1 qt. of mixture weighs 1.5 lbs.

No. 24

690 lbs. ground kafir
100 lbs. wheat bran
100 lbs. std. middlings
100 lbs. cottonseed meal, choice
10 lbs. salt

1 qt. of mixture weighs 1.1 lbs.

II. When roughage consists of legumes only

(Alfalfa, clover, soybean, or cowpea hay; that is, when no silage, corn stover, or hay other than those mentioned is fed.)

Feed 1 pound of one of the grain mixtures Nos. 7, 8, 9, 10, 11, or 12

TABLE IX—*Continued*

given above for each $2\frac{1}{2}$ pounds of milk produced, or $3\frac{1}{2}$ pounds for each gallon of milk.

III. When roughage is all non-legume

(Timothy, millet, redtop, oat, bluegrass or prairie hays, corn stover, corn silage or combinations of these.)

When milk yield is 1 to 25 pounds daily, feed 1 pound of one of the following grain mixtures for each 3 pounds of milk produced, or $2\frac{7}{8}$ pounds of the mixture for each gallon of milk.

When milk yield is more than 25 pounds daily, feed 1 pound of one of the following grain mixtures for each $2\frac{1}{2}$ pounds of milk produced, or $3\frac{1}{2}$ pounds of the mixture for each gallon of milk.

No. 25

300 lbs. wheat bran
300 lbs. linseed oil meal
200 lbs. ground corn
170 lbs. ground oats
20 lbs. ground limestone
10 lbs. salt

1 qt. of mixture weighs $\frac{7}{8}$ lb.

No. 27

350 lbs. ground barley
300 lbs. soybeans or linseed oil meal
150 lbs. gluten feed
170 lbs. ground oats
20 lbs. ground limestone
10 lbs. salt

1 qt. of mixture weighs 1.2 lbs.

No. 29

100 lbs. gluten feed
100 lbs. corn germ meal
100 lbs. std. middlings
100 lbs. dried beet pulp
170 lbs. ground oats
100 lbs. hominy feed
100 lbs. wheat bran
100 lbs. soybean oil meal
100 lbs. gluten meal
20 lbs. ground limestone
10 lbs. salt

1 qt. of mixture weighs 1 lb.

No. 26

300 lbs. soybean oil meal
400 lbs. ground corn
270 lbs. ground oats
20 lbs. ground limestone
10 lbs. salt

1 qt. of mixture weighs 1.1 lbs.

No. 28

200 lbs. choice cottonseed meal
100 lbs. ground soybeans
200 lbs. ground velvet beans
470 lbs. hominy feed
20 lbs. ground limestone
10 lbs. salt

1 qt. of mixture weighs 1.5 lbs.

No. 30

270 lbs. ground kafir
350 lbs. wheat bran
200 lbs. std. middlings
150 lbs. choice cottonseed meal
20 lbs. ground limestone
10 lbs. salt

1 qt. of mixture weighs $\frac{7}{8}$ lb.

The next step is to select the most economical grain mixture to be fed with the roughage chosen. Let us assume, for example, that mixtures Nos. 2 and 3 have been selected as those best suited to your conditions. Corn, oats, and barley are on hand, and mixture No. 2 calls for soybean oil meal as a protein supplement, while mixture No. 3 calls for linseed oil meal or ground soybeans. It has been found that the local dealer is offering 60 cents per bushel for corn, 60 cents per bushel for barley, and 40 cents per bushel for oats. He is selling soybean oil meal at \$60 per ton and linseed oil meal at \$50 per ton, but has no soybeans on hand. Compute from Table XXIII the relative economy of these feeds as sources of digestible protein when corn is worth 60 cents per bushel. It is found that when feeds are selling at the prices given, soybean oil meal furnishes digestible protein at a cost of 6.7 cents per pound, while linseed oil meal provides it at 7.2 cents per pound. The soybean oil meal, therefore, is the more economical source of protein.

Another point to consider is the cost per 1000 pounds of the mixture. In this case, mixtures No. 2 and No. 3, which belong to the same group, are practically equivalent in feeding value pound for pound. Compute the cost of each mixture as follows, neglecting the cost of the salt, which is the same in both cases.

COST OF MIXTURE No. 2

$$100 \text{ lbs. soybean oil meal @ \$60 per ton} \dots \frac{\$60}{2000} \times 100 = \$3.00$$

$$450 \text{ lbs. corn @ 60 cents per bushel} \dots \frac{\$.60}{56} \times 450 = 4.82$$

$$440 \text{ lbs. oats @ 40 cents per bushel} \dots \frac{\$.40}{32} \times 440 = 5.50$$

$$\text{Grinding 890 lbs. corn and oats @ 15 cents per cwt.} \dots 1.34$$

$$\text{Total cost, 1000 lbs.} \dots \underline{\$14.63}$$

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COST OF MIXTURE NO. 3

450 lbs. barley @ 60 cents per bushel.....	$\frac{\$.60}{48} \times 450 =$	\$5.63
75 lbs. linseed oil meal @ \$50 per ton.....	$\frac{\$50}{2000} \times 75 =$	1.88
465 lbs. oats @ 40 cents per bushel.....	$\frac{\$.40}{32} \times 465 =$	5.81
Grinding 915 lbs. corn and oats @ 15 cents per cwt.....		1.37
Total cost, 1000 lbs.....		\$14.69

At the prices given, the cost of mixture No. 2 is about the same as that of No. 3, even though the price of the protein supplement used in No. 2 sells at a higher price per ton and more of it is required to balance the mixture.

In deciding upon the feed to buy, the physiological effect, palatability, etc., as discussed under general information, must be considered, as well as the economy of the feed as a source of protein, and the cost per 1000 pounds of the mixture.

F. Compute amount of feed needed.—When storage space is available, it is usually economical to purchase the entire supply of feed needed for the year at one time. If records of milk production of the cows in the herd for the previous year are available, estimate the amount of milk to be produced during the winter feeding season. If no such records are at hand, assume a production of 18 pounds daily for Jerseys and Guernseys and 23 pounds daily for other breeds. From the feeding charts, compute the number of pounds of the grain mixture you are planning to use which it will be necessary to feed to produce this quantity of milk, and then the number of pounds of each of the feeds comprising the mixture. Example: Jersey cows, freshening in October. Period of grain feeding, October 1, to May 15, or 227 days. Pounds milk daily per head, 18. Grain mixture No. 20, consisting of 400 pounds corn, 465 pounds oats, and 125 pounds soybean oil meal, is to be used.

The directions specify 1 pound of the mixture to each 3 pounds of milk produced, which in this case would mean 6 pounds daily per cow. Six pounds daily for 227 days would require 6×227 or 1362 pounds of mixture. The amount of corn in the mixture would be $\frac{4.00}{10.00} \times 1362$, or 545 pounds; the amount of oats $\frac{4.65}{10.00} \times 1362$, or 633 pounds; the amount of soybean oil meal $\frac{1.25}{10.00} \times 1362$, or 170 pounds; the amount of salt $\frac{1.0}{10.00} \times$



FIG. 56.—SOYBEAN HAY IN SHOCKS FOR CURING

Soybean hay has increased greatly in popularity in the corn belt states during the past few years. It possesses high feeding value, comparing favorably with alfalfa hay.

1362, or 14 pounds. The amounts for the herd can now be readily computed.

G. Purchase feed needed.—Having determined the amount of feed needed, purchase the feed and store in a dry place. (See page 170 for discussion of the best season and other factors concerned in the purchase of feed.)

2. BALANCING THE RATION

Methods of balancing rations are omitted at this point, for the concentrate mixtures given in Section 1 of this chapter pro-

vide practically balanced rations when fed in accordance with the directions, thus saving the feeder the necessity of balancing them. The usual method of balancing rations, however, is given in Section 5 of General Information at the end of this chapter.

3. GRINDING FEED

Grinding feed for dairy cows is usually considered a very economical practice, especially when prices of feed and milk are high. With lower prices, however, the saving made by grinding, due to the increased digestibility, may be more than offset by the cost of grinding.

Procedure:

- A. Prepare grinding equipment.
- B. Weigh or measure grain.
- C. Mix and grind grain.

Equipment:

Grinder and power unit, scales or bushel measure, scoop shovel, oil can, fuel.

A. Prepare grinding equipment.—Belt the grinder to the power unit. Oil the grinder. Release the adjustment which controls the fineness of grinding, so that the grinder will require less power at starting. Put only a small quantity of grain in the grinder before starting. Fill all oil and grease cups on the power unit, and make sure that there is sufficient fuel (and cooling water, if used). Look over the whole outfit for loose burrs, or parts needing adjustment.

B. Weigh or measure grain.—Weigh out the amount of each of the grains to be ground and place conveniently near the grinder. If feeds are stored in overhead bins provided with spouts, weigh only small quantities (50 pounds) of each grain as needed. In case scales are not available, the grains may be

measured in a one-half or one-bushel measure, or a basket, the capacity of which in pounds has been ascertained, and the weight then figured with approximate accuracy.

Guesswork in mixing a ration usually leads to inaccurate and disappointing results.

C. Mix and grind grain.—Oats and corn are usually ground much more rapidly if mixed before grinding than if each is ground separately. If these two grains are to be ground, mix them in the proper proportion before putting them into the



FIG. 57.—RED CLOVER ON A HILL FARM IN INDIANA

Red clover is probably the most generally grown of all the legumes. It not only yields a large amount of nutritious hay, but is an excellent pasture crop as well.

grinder; or if the grinder has a large hopper, empty alternately small quantities of each into the hopper.

In starting the grinder, have but a limited amount of grain in the grinder. Start the grinder slowly and let it come to full speed before tightening the adjustment regulating the fineness of grinding. Then put more grain into the hopper and adjust the grinder to the desired degree of fineness. The more finely ground the grain, the more readily digestible; but the finer the grinding, the more power required.

4. MIXING FEED

It is necessary to mix the ingredients of the concentrate mixture thoroughly, for unless this is done, the proper amounts of each of the constituents can not be fed. Various mixing machines are on the market, but the simplest method, and a very satisfactory one, is mixing by hand.

Procedure:

- A. Prepare clean floor.
- B. Spread ground grain on floor.
- C. Add mill feeds and salt.
- D. Mix thoroughly with shovel.

Equipment:

Broom, baskets or measure, scoop shovel.

A. Prepare clean floor.—Select a portion of a smooth floor as free from cracks as possible. Sweep thoroughly, for dirt in the concentrate mixture decreases palatability and may sometimes prove harmful.

B. Spread ground grain on floor.—If the grain has been weighed or measured before grinding, spread the ground grain as it is taken from the grinder on the clean portion of the floor. If unweighed, measure or weigh out the required amount of ground grain and spread on the floor. A small batch of 200 to 400 pounds may be mixed readily if the feed is piled in a heap, but large batches are mixed more thoroughly and with less labor when spread in a long, low pile not more than 2 or 2½ feet deep.

C. Add mill feeds and salt.—To the pile on the floor, add some of the mill feeds, then more of the ground grain, until all the ingredients have been added. If the mill feeds are in 100 pound sacks it is, of course, unnecessary to weigh them; but if in bulk, they must be weighed or measured as in the case of the grain being ground.

It is recommended that 1 pound of common salt be added to the mixture for each 100 pounds of concentrates. This increases the palatability of the mixture and at the same time is a simple method of supplying some of this necessary substance. Distribute the salt uniformly over the pile of concentrates.

D. Mix thoroughly with shovel.—The best method of hand mixing is for two men with scoop shovels, one on either side of the pile, to work together. One person can do the job, however.

Shovel the concentrates into a new pile of the same shape, 2 or 3 feet away. Repeat this operation until the mixture appears to be uniform in composition, as judged by color, texture, etc. Place in a bin or sacks until needed for feeding.

5. FEEDING SILAGE

In order to obtain the best results from the feeding of silage, it is necessary to observe certain simple precautions in handling and feeding.

Procedure:

- A. Remove needed amount of silage from silo.
- B. Carry to mangers in cart or basket.
- C. Weigh or measure silage for each cow.
- D. Feed frozen silage with caution.

Equipment:

Silage fork or silage cart, basket, scales.

A. Remove needed amount of silage from silo.—There is no very practical means of weighing out the exact amount of silage needed for one day's feed as it is being taken from the silo. The approximate amount necessary is soon learned from experience.

In removing from the silo, use a silage fork, removing a layer 1 or 2 inches thick from the surface without disturbing the silage

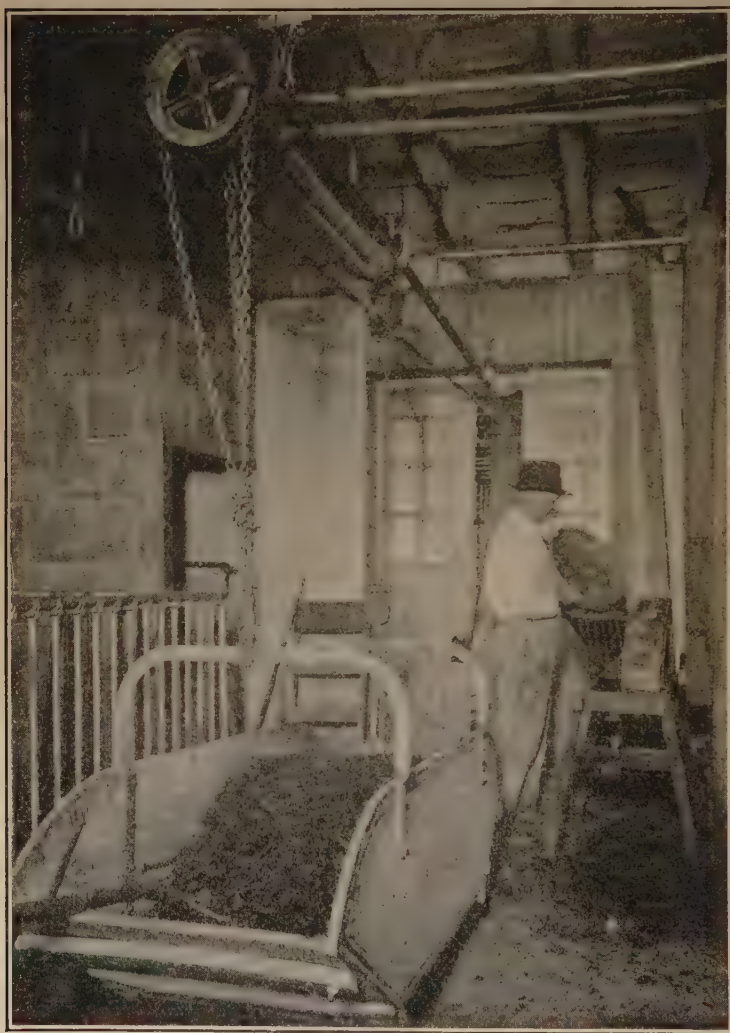


FIG. 58.—SOME CONVENIENCES IN THE DAIRY BARN

A feed carrier containing silage and a silage fork is shown in the foreground. This carrier is operated upon an overhead track and can be raised and lowered, but feed carriers of similar design may be mounted upon low wheels.

The man in the background is emptying roots into a machine which slices them into a convenient size for feeding.

below. See Fig. 58. It is best to remove each day a layer of silage from the entire surface exposed in the silo, keeping the surface level. Freezing of the silage at the surface in cold weather may be prevented in whole or in part by devices similar to those described for the prevention of spoilage in hot weather. See Chapter VIII, Section 11. Digging holes in the silage at any point is very likely to cause extensive spoilage.

B. Carry to mangers in cart or basket.—The best method of handling silage in most barns is by means of a silage cart. See Fig. 58. This is placed at the bottom of the silo chute and filled as the silage is thrown down the chute. The cart may hold an entire day's supply or enough for one feed only. In small barns the silage is usually allowed to fall on the floor at the bottom of the chute and carried to the cows in a basket.

C. Weigh or measure the silage for each cow.—Weigh the silage in a basket placed on platform scales, or pass a rope through each handle of the basket and hang the basket from a spring balance. Another satisfactory method is to determine the capacity of the basket and then measure the silage to each cow. Scooping the silage into the mangers by shovel or silage fork is inaccurate and wasteful.

Feed from $2\frac{1}{2}$ to 3 pounds of silage daily per 1000 pounds live weight of the cows. Some cows will readily consume more than this, and, when corn is low in price, silage is usually an economical feed and may be fed safely up to 4 pounds per 1000 pounds live weight. Liberal feeding of poor-quality silage is likely to cause digestive disturbances.

Weigh or measure out one-half the amount to be given daily to each cow. Feed the same amount both morning and evening. Place the silage in the bottom of the manger, so that the concentrate mixture may be placed upon it. If any considerable quantity of hay has been left in the manger from previous feedings, push it to one side or remove it before placing silage in the manger.

Feeding silage before milking is not objectionable, provided the silage is of good quality and free from foul odors. Ill-

smelling silage may taint the milk if present in the barn at milking time or if fed shortly before milking.

D. Feed frozen silage with caution.—Small amounts of frozen silage are not injurious, but if fed in large amounts or over a period of several days it is likely to cause indigestion and scours.

Keeping the surface of the silage level and covered with several thicknesses of blankets or canvas helps to prevent freezing. A silage cart may be filled with partly frozen silage and allowed to stand in a warm stable or room for twenty-four hours before feeding, stirring the silage occasionally. The heat of the room, together with the heat produced in the fermentation which starts, helps to thaw the silage.

When the silage next the wall of the silo freezes solid, it is usually necessary to leave this until the weather becomes mild enough for the silage to thaw. This may be fed safely if fed within a few days after it thaws. In case a large amount of frozen silage next the walls has been left exposed, discard all moldy or decayed portions before feeding.

6. FEEDING CONCENTRATES

Directions have been given for selecting a suitable concentrate mixture and for grinding and mixing concentrates. On many farms, however, the concentrates fed consist of ready mixed and ground feeds purchased on the market. Whichever sort are used, a few simple principles in the feeding of the concentrates must be followed.

Procedure:

- A. Feed in proportion to milk production.
- B. Feed a little more than required, rather than too little.
- C. Weigh concentrates and place on silage in manger.

Equipment:

For large herds: a grain cart, carrier, or special feed truck, spring balance, weigh pail, hand scoop, feeding chart. For small herds: galvanized iron basket, spring balance, weigh pail, hand scoop, feeding chart.



FIG. 59.—AMOUNTS OF LIME IN SOME COMMON FEEDS

Note the large amounts of lime in the legume hays and the small amounts in corn and oats

A. Feed in proportion to milk production.—Note the amount of milk each cow is producing and make out a feeding chart. List each cow by number or name and make a note of the amount of concentrates to be fed at each feeding. For example,

if 8 pounds are to be fed daily in two feeds, enter 4 pounds on the chart.

Determine the amount of concentrates to be fed from the directions given in concentrate mixtures for the different breeds (p. 134). If the concentrate mixture used is a ready-mixed one, the amount to be fed in proportion to milk production can best be determined from actual practice, although the general rule of 1 pound of concentrates for each 3 to 3.5 pounds of milk produced by Holsteins, Ayrshires, and Brown Swiss, or 1 pound of concentrates for each 2.5 to 3 pounds of milk produced by Jerseys and Guernseys, may be used as a guide.

The amounts of hay and silage to be fed may also be entered on the same chart, if desired. Attach the chart to the grain cart by means of a spring clip board, common board and thumb tacks, or other means, so that it will be in plain view during the feeding operations.

B. Feed a little more than required, rather than too little.—As there is a considerable difference in the amount of concentrates required in proportion to milk by different cows of the same breeds, each cow must be studied individually. Perhaps a cow is being fed all the concentrates called for by the directions, but seems to be losing weight unduly. It is advisable to increase the amount of concentrates slightly. Another cow may be adding undue weight when fed according to directions, so the proportion of concentrates may be reduced slightly. Always feed a little more than actually required, rather than too little, for over a long period cows are benefited by being kept in a good state of flesh, and this small amount of additional feed is not wasted, but is a good investment. It is also true that if a cow is being fed too little to enable her to produce at her best, this will usually not be discovered until she is fed a little more than seems to be actually required so that she has opportunity to increase her production.

C. Weigh concentrates and place on silage in manger.—Concentrates usually are fed immediately after the silage. Follow the feeding chart you have made out, and weigh the

concentrates for each cow at each feeding. If a spring balance is used, as shown in Fig. 28, hang the empty weigh pail on the balance and adjust one of the hands to read zero. Then take the readings from this hand. Use a small hand scoop to place the concentrates in the pail. Spread the concentrates on the silage, which has previously been placed in the manger.

The time spent in weighing the concentrates usually gives better returns than the time spent in any other operation in connection with the herd; but if the herdsman feels that he can not spend this amount of time, the concentrates may be fed in nearly the correct amounts by measuring in a 4- or 6-quart measure, or a pail with vertical sides which has been marked to indicate single quarts.

7. FEEDING HAY

Hay should be fed liberally but not wastefully. The best time to feed it is after milking

Procedure:

- A. Bring hay from mow.
- B. Feed liberal amounts.
- C. Feed after milking.
- D. Check up amounts fed.

A. Bring hay from mow.—Take a supply of hay for one feeding from the mow and place in the hay chute; or, in case a large hay chute is not available, take the hay into the feeding alley. Do this long enough before milking to make sure that all dust will have settled before milking is begun. In barns where very high-grade milk is being produced, do not bring the hay into the milking barn until after the cows have been milked. The amount of hay necessary for one feeding may be learned readily by experience.

B. Feed liberal amounts.—As a rule, feed hay liberally, since it is generally a cheap source of nutrients. The usual

plan is to feed all that the cows will consume readily, although if hay is very high in price, it may be desirable to limit the amount.

C. Feed after milking.—After milking is finished and the milk removed from the milking barn, feed the hay to the cows.



FIG. 60.—CORN IN THE SHOCK

Dairy farmers must utilize all feed grown on the farm, as far as possible. After the silo has been filled, the remaining corn should be cured in the shock. Well-preserved stover makes excellent feed and the refused part forms good bedding if the stover has been shredded.

As a rule, feed good-quality hay in equal amounts morning and evening. In the case of soybean hay with coarse stems, or of hay that is not of the best quality, feed the greater portion of the day's feed in the evening, so that the cows will have a longer time to pick the hay over. Do not feed good-quality hay in such large amounts that part of it remains in the manger

several hours for the cows to nose about. To get the cows to eat as much hay as possible, feed it in smaller amounts morning, noon, and night, or even more often, and reduce the amount of silage or other roughage.

Sometimes one has on hand two or more kinds of hay differing in feeding value. For example, suppose there is on hand 1 ton of alfalfa hay to every 3 tons of mixed clover and timothy hay. Do not feed the cows on the alfalfa alone until the supply is exhausted, but give a small feed of the alfalfa hay in the morning and then a very liberal feed of the clover and timothy in the evening.

D. Check up amounts fed.—It is necessary to know the amount of hay being consumed in order to compute feed costs. Weigh the amount of hay fed at least one day each month. In case the barn is equipped with individual mangers, and the cows are fed individually, weigh the hay fed each cow. Otherwise, weigh the hay given each pair of cows.

To weigh the hay, place the hay for each cow in a large tub on portable platform scales. In case such scales are not available, place the hay in a pile, slip a rope around it, and suspend from a spring balance scale. Keep a record of the amount of hay fed.

8. FEEDING DRY ROUGHAGE OTHER THAN HAY

Such feeds as corn stover, kafir, and sorghum cane may be utilized to advantage if it is understood that they can not take the place of legume hay.

Procedure:

- A. Feed coarse roughage in yard.
- B. Feed shredded stover in barn.
- C. Use corn-stalk pasture sparingly.

A. Feed coarse roughage in yard.—Do not feed long corn stalks or other materials of this kind, such as kafir or sorghum

cane, in the barn, but feed them in a rack in the yard. Once daily, return to the rack any good feed that the cows may have spilled out. Be sure the rack is placed in a well-drained location or on a pavement. Clean the rack frequently. If the yard is paved, allow the refuse stalks to remain where the cows will tramp on them, thus converting them into manure which can be handled readily.

Remember that feeds such as corn stover, kafir, etc., are non-legumes and do not take the place of legume hays in feeding value. Further, but a small part of the corn stover fed is

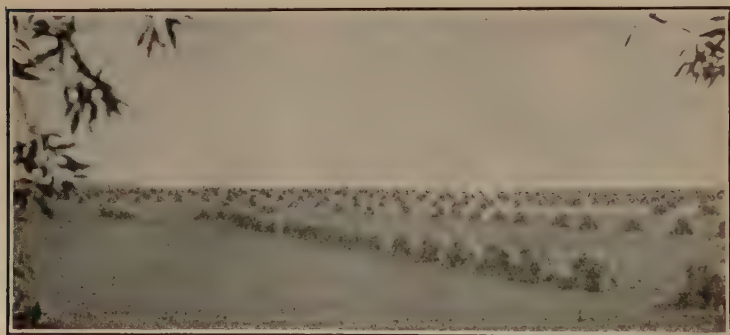


FIG. 61.—OATS IN THE SHOCK

Oats yield somewhat less digestible nutrients per acre than corn but they form an excellent feed for dairy cows.

actually eaten, so be sure to supply plenty of hay in addition to stover.

B. Feed shredded stover in the barn.—Feed shredded corn stover in the barn. This feed spoils readily if exposed to rain and is likely to blow about if fed outdoors. When it is stored and fed in a dry place, the part that is refused makes excellent bedding.

C. Use corn-stalk pasture sparingly.—Do not pasture milking cows in standing corn stalks from which the ears have been removed, during cold, inclement weather, or after the best part of the feed has been secured. Corn stover is at best a feed

low in nutritive value, and becomes less valuable as the rains leach the nutrients from the leaves. It is doubtful, if, under most conditions, the cows secure enough feed to offset the effects of excessive exercise and exposure.

9. FEEDING ROOTS OR PUMPKINS

Feeds of this character require a certain amount of preparation, and care should be used in calculating the quantity required.

Procedure:

- A. Discard damaged portions.
- B. Slice or chop.
- C. Feed in amounts similar to corn silage.

Equipment:

Large butcher knife or corn knife, hand or power root slicer if roots are to be fed in large quantities.

A. Discard damaged portions.—In preparing feeds such as mangels, rutabagas, pumpkins, etc., remove any rotten portions with a large knife.

B. Slice or chop.—Reduce the materials to a size such that the cows can eat them conveniently. This can be done by hand with a large butcher knife or a corn knife, or by means of a machine specially designed for this purpose. Roots that are round in shape, even if they are small enough to be taken into the mouth whole, should be cut at least once to make them irregular in shape. Small, round roots may lodge in the cow's gullet.

C. Feed in amounts similar to corn silage.—Feed roots or pumpkins in the same amounts as corn silage. Place them in the bottom of the manger, as with silage, and empty the concentrate mixture over them.

In case the supply of roots is limited, feed small amounts daily, so that they may be fed over as long a period as possible. The seeds of the pumpkins need not be removed, provided the above directions as to the amounts to be fed are followed.

10. FEEDING DRY COWS

The feed of the dry cow should be planned to meet the requirements of the individual case.

Procedure:

- A. Ascertain length of dry period.
- B. Study condition of cow.
- C. Feed liberally.
- D. Provide laxative feeds before calving.

A. Ascertain length of dry period.—Ascertain from the breeding records the date of next calving and calculate the length of time each cow will be dry. Note these facts in a convenient place, such as the feed record sheets.

B. Study condition of cow.—Study the condition of each cow, as regards her state of flesh. Make a note in connection with the length of the dry period as to whether the cow is now sufficiently fat, should be increased moderately in flesh, or needs heavy feeding.

C. Feed liberally.—Feed the cow during the dry period so that she will be in an excellent state of flesh at calving time. If she is thin in flesh, begin to feed her quite heavily during the early part of the dry period, so that it will not be necessary to feed more than a light ration during the ten days previous to calving.

Cows on good pasture need little or no additional feed during the dry period, unless they are in very thin flesh, in which case concentrates should be fed in addition. When pasture is not available, feed hay and silage liberally instead. To cows in moderate flesh, feed 2 to 4 pounds of concentrates daily in addi-

tion to roughage. To cows in thin flesh, feed 4 to 6 pounds daily of a grain mixture such as the following:

200 lbs. ground corn, hominy feed, or ground barley.

100 lbs. ground oats or wheat bran.

D. Provide laxative feeds before calving.—For a period of ten days to two weeks before calving, provide feeds that will exert a laxative effect on the cow. Pasture furnishing plenty



FIG. 62.—THRESHING GRAIN WITH A SMALL OUTFIT

In dairy sections, straw, the by-product from threshing, is carefully saved by building it into good stacks or blowing it from the threshing machine into the barn. On grain farms, straw is often wastefully burned.

of fresh green grass, or liberal amounts of legume hay or silage, will usually suffice; but if only dry feed is given and good legume hay is not available, feed a concentrate mixture such as one of the following:

(1) 100 lbs. ground oats, 100 lbs. wheat bran.

(2) 200 lbs. ground oats, 100 lbs. linseed oil meal.

(3) 100 lbs. each of ground oats, wheat bran, and linseed oil meal.

Feed 2 to 4 pounds of the mixture daily, depending upon the condition of the udder. If the udder becomes badly caked, omit grain feeding and feed legume hay liberally, with a small amount of silage or roots.

11. FEEDING AFTER FRESHENING

The cow that has calved should be fed lightly at first, and her allowance of feed should be gradually increased.

Procedure:

- A. Feed lightly.
- B. Provide laxative feeds.
- C. Increase feed gradually.

A. Feed lightly.—Offer the cow but little feed during the first twenty-four hours after calving. The liberal feeding before calving is designed to supply reserve flesh on the cow's body which can be used to tide her over this period.

B. Provide laxative feeds.—Be sure that the feed offered during the first two or three days after calving is laxative. In case the previous feeds have not been of this nature, feed a bran mash within a few hours after calving. Prepare this as follows: Place 3 to 5 quarts of wheat bran in a pail having a capacity of 12 quarts or more. Pour enough boiling water over the bran to moisten it thoroughly. Allow to stand ten to fifteen minutes. Add just enough cold water, while stirring, to make it cool enough for the cow to consume. Feed while still warm.

C. Increase feed gradually.—During the second and third days after calving feed good-quality legume hay in such amounts as the cow cares to consume and one-half the usual allowance of silage. Feed only a small amount of concentrates, 2 to 3 pounds daily being sufficient. The concentrate mixture that was used just before calving is suitable. (If the udder is severely caked, feed little or none of the concentrate mixture

for a few days.) Gradually substitute the concentrate mixture used for the herd, increasing the amount from the first feeding, as a rule, at the rate of about $\frac{1}{2}$ pound daily, so long as the cow continues to give more milk. Make the substitution complete within a week after calving.



FIG. 63.—WHEAT STRAW ON THE WAY TO MARKET

Wheat, barley, and oat straw are of little value as a feed for high-producing dairy cows. Oat straw may sometimes be used economically as part of the roughage for dry cows and young stock but must be supplemented with legume hay or other protein feed.

12. FEEDING MINERAL SUPPLEMENTS

Knowledge of the exact requirements of dairy cattle for mineral supplements is still incomplete. Until further and more definite information is available, nothing more than general recommendations can be made.

Procedure:

- A. Study mineral content of ration.
- B. Ascertain relative costs of available mineral supplements.

C. Feed necessary amounts of supplements.

D. Supply common salt.

A. Study mineral content of ration.—Turn to Table XXIV and determine whether the ration being fed is relatively high or low in lime and phosphorus content. It will be noticed that certain classes of feeds, such as the legumes, are very high in lime, while other classes, such as the cereal grains, are very low. By the use of these values and the requirements of cows in milk as given in Table XXV, compare the amounts of lime and phosphorus in the ration with the amounts necessary. In general, it will be found that rations containing no legume hay will be much lower in lime content than those containing legume hay, and that the lime content of non-legume rations is too low for high milk production.

B. Ascertain relative costs of available mineral supplements.—If it is found that the ration is low in both calcium and phosphorus, learn the prices of materials such as steamed bone meal and rock phosphate, which supply both these elements. If the ration is low in calcium only, obtain the price of finely ground limestone also.

C. Feed necessary amounts of supplements.—Having ascertained the most economical supplement, add a sufficient amount to the concentrates before mixing. As a rule, 2 to 4 pounds of the supplements added to each 100 pounds of concentrates are sufficient to cover any deficiency. Do not add more than 1 or 2 pounds to each 100 pounds of concentrates if the dry roughage consists largely of legume hay.

The practice of placing these supplements, mixed with one-fourth their weight of salt, in a box in the exercising yard is not recommended, since some cows then eat too much and others do not consume enough.

D. Supply common salt.—Supply the cows with all the common salt they care to eat. The common barrel salt is usually the most satisfactory kind for dairy cows. Part of the salt may be supplied by mixing it with the concentrates, as sug-

gested in Table IX, where it helps to increase the palatability of the mixture. Sometimes hay when being put into a mow is salted at the rate of 8 to 10 pounds of salt to each ton.



FIG. 64.—A LARGE YIELD OF HAY FROM AN ANNUAL LEGUME

When clover or alfalfa winter-kills, a dairy farmer may secure a large amount of a good legume hay in three to five months' time by planting soybeans.

It is generally advisable to place salt in a box in the yard to which the cows have access. If cows are not turned into the yard regularly, however, as during the winter months, a sufficient amount of salt may usually be supplied by mixing salt with the concentrates at the rate of 2 pounds of salt per 100 pounds.

13. INSURING A SUPPLY OF VITAMINS

In regard to the vitamins that should be supplied to cows, the recommendations are still less definite than in the case of mineral supplements. It is known that dairy cows utilize some of the vitamins present in feeds, but the extent to which vitamins must be supplied and the best manner in which to do this have not yet been fully determined.

Procedure:

- A. Study vitamin content of ration.
- B. Supply some vitamin-rich feeds.

A. Study vitamin content of rations.—Make a list of the feeds contained in your ration and grade each feed as high or low in vitamin content in accordance with the information in Table XXVI. Rate the ration as a good or a poor source of vitamins.

B. Supply some vitamin-rich feeds.—In case you have rated your ration as poor in vitamins, supply some of the feeds that are rich in vitamins.

It should be recalled in this connection that the need and utilization of minerals and vitamins by the body is affected by sunlight, and that provision should be made for exposure of the animals to direct sunlight for a short period every day when possible.

GENERAL INFORMATION

1. THE USES MADE OF FEED BY THE DAIRY COW

It is commonly thought that cows need feed chiefly for milk production, but there are also several other purposes for which feed is required.

A. Growth.—Cows usually continue to grow until they are at least four or five years of age. Up to that time, therefore,

generous allowance in feeding should be made for growth requirements.

B. Maintenance.—The cow has constant need of feed for the repair of her tissues and for energy to carry on the life processes. Even the best cows use as much as 35 per cent of the total feed consumed simply to maintain the body without gain or loss in weight, while the poorer producers use as much as 65 per cent.

C. Production of milk.—Feed, in addition to that used for maintenance, is necessary for the production of milk. The store of fat which it is desirable for cows to have at the time they freshen may be drawn upon for a time for milk production, but the normal weight of the cows must be restored later if they are to remain healthy and able to keep up their production.

D. Increase in weight.—Cows kept under good conditions normally increase in weight during the latter part of the lactation period and during the rest period. Feed, in addition to that needed for maintenance and milk production, is required for this increase.

E. Production of offspring.—The growth of the unborn calf (or fetus) is a fifth purpose for which a cow requires feed. She needs little for this purpose, however.

2. THE COMPOSITION OF FEEDS

Feeds may be grouped roughly into two classes, based upon composition and appearance, as follows: (1) **Concentrates**, such as farm grains and mill by-products. Most of these are heavy in proportion to bulk and contain a small amount of fiber, or cellulose. (2) **Roughages**, feeds bulky in proportion to weight, such as hay, straw, silage, grass, and roots. Most of these feeds contain large amounts of fiber. Some roughages, such as silage, fresh green grass, and roots, are high in water content and therefore are termed **succulent feeds**.

There are six classes of substances in most feeds: protein, carbohydrates, fats, mineral matter or ash, vitamins, and water.

Protein is the only one of the principal constituents that contains nitrogen. Protein is very essential, for it is necessary in growth and in the repair of the tissues, as a constituent of milk, and in the development of the fetus. Without protein, these processes could not take place. Protein is usually the



FIG. 65.—CULTIVATING SOYBEANS TO DESTROY WEEDS

The rotary hoe is a useful implement in raising soybeans that have been sown broadcast or seeded with a wheat drill. The crop may be cultivated several times before the plants reach a height of 10 to 12 inches, thus destroying most of the weeds and thereby greatly improving the quality and yield of the hay.

most costly substance in the ration, for feeds rich in this constituent are relatively scarce.

Carbohydrates comprise the starches, sugars, etc., and the crude fiber, or cellulose. Corn, oats, barley, and similar grains contain large amounts of starch. The starches and sugars are utilized in the formation of the sugar and fat of the milk and

also in body fat; they further provide large amounts of energy, or heat. Crude fiber is the least digestible part of feeds, and for this reason feeds very high in fiber, such as corn cobs, cottonseed hulls, etc., have a relatively low feeding value.

The term fats as applied to feeds includes the true fats and oils. These serve the same purposes in the body as the carbohydrates. The term fats also includes those substances in the feed which are soluble in warm ether, such as the coloring matters, waxes, resins, etc. These latter substances form but a small amount of most feeds, and for the most part are indigestible.

Mineral matter, or ash, is necessary in the growth of the skeleton. Its presence in the vital parts of the body also controls, in some unknown way, many of the body processes, such as the contraction of the muscles. Mineral matter is one of the chief needs of the cow in the production of milk, about seven-tenths of a pound being present in 100 pounds of milk.

Vitamins are substances known to be present in feeds in very small amounts, although practically nothing is known of their composition. Vitamins are necessary for growth and also for maintenance. Fresh green feeds, such as the leaves of legumes, and also the germs of the grains, are good sources of vitamins for the dairy cow. Hay cured under good conditions retains much of its vitamin value, but long-continued exposure of feeds to sun and weather greatly reduces the value of the vitamins.

Water is present in all feeds. Silage, roots, and fresh grass contain from 65 to 90 per cent of water, and even the farm grains when cured for storage contain from 9 to 12 per cent.

3. CHARACTERISTICS OF THE IDEAL RATION

No one feed that is now known completely fulfils the requirements of an ideal ration for milk production, but spring pastures most nearly approach the ideal. Since fresh green pasture grass is such a valuable feed, some of its characteristics should be considered as those desirable in barn rations.

A. Amount.—Abundant spring pastures satisfy the appetites of the cows by furnishing so much feed that the animals are able to secure all they wish in a short time, and then have plenty of time to lie down or to stand quietly while they remasticate the feed, by the process commonly known as chewing the cud. The cows' appetites must be satisfied if the best results are to be secured. When cows do not receive sufficient feed to provide the necessary bulk, they are inclined to pick up refuse feed or bedding, which has little nutritive value. Young pasture grass, particularly early in the spring, however, does not furnish quite an ideal ration from the standpoint of the amount of *nutritive material*, because it is so high in water content that a cow cannot consume enough of it for the production of large amounts of milk.

The greater the amount of feed of a balanced ration consumed by a cow of pronounced dairy tendency, the greater the economy with which milk is produced.

Palatability.—Fresh green pasture grass is the most palatable of all feeds for dairy cows. The fact that they consume large amounts of such grass shows a close relationship between palatability and the amount consumed. It is often difficult to secure palatability in the winter ration, but it may be provided to some degree in several different ways: (1) by using succulent feeds, such as silage and roots; (2) by using only those feeds which have a pleasant odor and flavor; and (3) by using a number of different feeds in the concentrate mixture and by feeding two or more kinds of roughage. Moldy or spoiled feeds should not be used. They not only lack palatability, but also are dangerous to the health of the herd.

C. Digestibility.—Pasture grass is much more completely digested when it is young and tender than after it becomes mature. Carefully cured hay is nearly or quite as digestible as the grass from which it was made, but hay cured by careless methods, by which the leaves and finer parts of the stems are lost, or hay that has been leached by rain, is much less digestible.

From 65 to 90 per cent of the dry matter of cereal grains and

their by-products is digestible, while only 50 to 70 per cent of the dry matter of high-grade roughages is digestible. Some roughages which are very high in crude fiber content and low in other digestible nutrients, such as the straws of the cereals and the hulls of various seeds, have so little food value that they should be given little place in the ration of the dairy cow in milk. If high production is expected, a dairy cow must not be forced to eat large quantities of such feeds. Other roughages quite high in fiber, such as well-cured corn stover, make valuable supplements to legume hays and fill an important place as feeds for dry cows.

It should be noted that the analyses of proprietary mixed feeds or mill by-products, as given on the tags attached to the sacks, are nearly always stated in terms of *total* nutrients rather than *digestible* nutrients. It is thus impossible to judge accurately of the digestibility of such a feed, unless the ingredients are stated. In cases of feeds such as wheat bran, linseed oil meal, etc., it may be assumed that their digestible nutrient content conforms closely to the averages given for those feeds in Table XXVII. In the case of mixed concentrated feeds, where the ingredients are not stated, the crude fiber content should not exceed 9 per cent in good-quality materials. If more crude fiber than this is present, it is likely that low-grade concentrates, such as screenings or oat hulls, etc., have been used. Concentrated mixtures containing alfalfa meal are usually an exception to this rule, since the presence of the alfalfa adds materially to the crude fiber content.

The effect of grinding on the digestibility of roughages has not yet been fully determined.

D. Succulence.—One of the characteristic and valuable features of fresh pasture grass is its succulence. Succulent feeds stimulate the appetite and also have a slightly laxative effect upon the digestive tract, both valuable features of a ration. Pasture grass, corn silage, soiling crops, and roots are the common succulent feeds, corn silage being the most common and usually the most economical for winter feeding.

E. Physiological effect.—Some feeds exert a particular effect upon the action of the body cells, termed a physiological effect. Fresh pasture grass produces a laxative effect and also keeps the body in good working order, either on account of other physiological actions or owing to the presence of some nutritive substances about which little is known as yet. The best rations for milk production are those which have a slightly laxative effect. Some of the feeds that produce this effect are the succulent feeds, legume hays, linseed oil meal, wheat bran, and molasses. Most of the feeds that are high in crude fiber, with the exception of the legume hays, as well as cottonseed meal, tend to constipate dairy cows.

Certain feeds relatively high in oil content, such as linseed oil meal, soybeans, sunflower seed, etc., tend to put "gloss," or "finish," on an animal; they aid in making the hair and hide soft and pliable.

F. Bulk.—Pasture grass is bulky in proportion to its weight and on account of its bulk helps to promote the normal action of the digestive tract. It is popularly believed that concentrate mixtures should be bulky. Feeds such as ground oats and wheat bran help to provide bulk in concentrate mixtures. Some of the means of securing bulk are the grinding of whole ear corn, and the mixing of the concentrates with chaffed hay or silage. Concentrate mixtures that weigh not more than 1 pound per quart have desirable bulk.

G. Balance.—A discussion of balanced rations has been given in another section (see p. 171). Pasture grass, when young, is practically a balanced ration for moderate milk production, but as it matures the proportion of protein becomes less and the balance is lost.

Usually concentrate mixtures should contain from 10 to 20 per cent digestible protein. When the proportion of protein is too small, either the protein of the body tissues is drawn upon to supply protein for the milk, or the milk flow drops to the level of the amount of protein fed. When too small a proportion of protein is fed, the excess carbohydrates and fat, which normally

should be used for milk production, must go for the construction of body tissue. An excess of protein, on the other hand, is no more valuable than the same amount of carbohydrates, and since protein is usually the most expensive part of the ration, it is wasteful and may be harmful to feed more than is needed. *Too small a proportion of protein in the ration is one of the greatest causes of failure to secure greater milk production and probably larger profits, particularly on farms where large amounts of*



FIG. 66.—GROWING PROTEIN ON THE FARM

Protein is usually the most expensive part of the feed for milk cows. Good-quality soybean hay contains more than 200 lbs. of protein per ton. The plot of soybeans shown in this illustration yielded 3 tons of hay per acre.

low-protein feeds, such as corn, corn stover, corn silage, oats, timothy hay, redtop hay, prairie hay, etc., are fed to the dairy herd.

H. Cost.—The final and often the deciding factor in the selection of a suitable ration is the cost, for some of the most desirable feeds should sometimes be omitted from the ration on account of their high price, when other cheaper feeds may be substituted satisfactorily. The cost of feed usually makes up from 50 to 70 per cent of the total cost of milk production.

The market prices of feeds change frequently, giving an opportunity for the exercise of business judgment in the selection of economical feeds. Digestible nutrients are usually secured most cheaply in unmarketable roughage, such as corn silage, corn stover, and the lower grades of hay. There is not a wide difference in the cost of digestible nutrients in marketable roughage and concentrates, the cost of nutrients in purchased hay sometimes exceeding that of concentrates. The concentrates that contain high percentages of protein, such as cottonseed meal, linseed oil meal, gluten meal, etc., usually furnish digestible protein at a lower cost per pound than feeds low in protein, such as corn, oats, and barley.

4. SEASON FOR PURCHASE OF FEEDS

A study of the wholesale prices of feeds over a period of years at the Chicago and Milwaukee markets shows wide differences in the price of feeds during different seasons of the year. The prices of some feeds may be as much as \$15 per ton more during the month of highest price levels than during the month of lowest prices.

The chief factor affecting the prices of feeds is supply and demand. The supply and demand are in turn affected by many different factors, the chief ones being the following:

A. Size of crop and time new crop comes on the market.—

When a crop is normal or above normal in quantity, the price usually declines shortly after harvest. Thus the price of oats is generally lowest in August and September and that of corn in December and January.

B. The season of barn feeding.—

The demand for feeds, particularly mill feeds, increases as soon as the fall or winter season of barn feeding begins. The prices usually increase at that time and remain above the average for the year until nearly the close of the barn feeding season.

Thus during the ten years from 1907 to 1916, inclusive, the average prices of gluten feed and linseed oil meal were lowest in May; wheat bran was lowest in June; and hominy feed was

lowest in March. During the nine years previous to 1917, cottonseed meal prices were lowest in March.

Feed prices during 1922 and 1923 were somewhat irregular, but the lowest prices of cottonseed meal, gluten feed, wheat bran, linseed oil meal, hominy feed, and middlings prevailed during the months of April to September, inclusive. During 1924, the prices of five of these feeds were lowest in May, gluten feed being lowest in April.

5. BALANCING THE RATION

It is essential that dairy cattle, particularly cows in milk, be fed a sufficient amount of each of the constituents of feeds to meet their needs, and, for the sake of economy, that they be fed no more than they need. An amount of one or more feeds which will exactly meet the requirements of an animal for a twenty-four-hour period, is termed a balanced ¹ ration.

In Chapters IX and X are listed rations that have been found to be approximately balanced, thus saving the feeder the trouble of making the computations involved in balancing the ration. A method of balancing rations, however, is included here for the sake of completeness.

There are a number of different feeding standards, nearly all of which are approximately correct. The Morrison Standard is used here for the sake of simplicity.

It is first necessary to know the weight of the cow for which the ration is being calculated, and then the amount and butter-fat content of the milk being produced. In case the weight of the cow and the fat test of the milk are not known, turn to Table VI and find the averages given for the breed to which the cow belongs. Using these averages, and knowing the

¹ A "balanced" ration was formerly considered to be one in which the feeds furnished digestible protein, digestible carbohydrates, and digestible fat in certain proportions. Now, however, the term includes, in addition to its original meaning, the provision of other nutritive substances, such as minerals and vitamins, in proper amounts. For further discussion, see Section 3 of General Information above.

amount of milk produced, turn to the Morrison Standard given in Table XXVIII.

Let us assume that a ration for a cow weighing 1200 pounds and producing daily 40 pounds of milk testing 3.5 per cent fat is to be formulated. The standard states that a cow requires for maintenance 0.7 pound digestible protein and 7.925 pounds total digestible nutrients daily per 1000 pounds live weight. The 1200-pound cow, therefore, will require one-fifth more than this, or 0.84 pound digestible protein and 9.510 pounds of total digestible nutrients.

Each pound of 3.5 per cent milk requires .049-.061 (average .55) pound digestible protein and .284-.316 (average .3) pound total digestible nutrients; therefore, 40 pounds of milk requires 40 times these amounts, or 2.2 pounds digestible protein and 12.0 pounds total digestible nutrients. These results may be arranged as follows:

RATION FOR 1200-POUND COW PRODUCING 40 POUNDS OF 3.5 PER CENT MILK DAILY
DAILY REQUIREMENTS

	Digestible Protein, Pounds	Total Digestible Nutrients, Pounds
For maintenance of 1200-lb. cow.....	0.84	9.51
For 40 lbs. 3.5 per cent milk.....	2.20	12.00
Total daily requirements.....	3.04	21.51

The amount of nutrients supplied in the roughage may be calculated by weighing the hay, silage, stover, etc., that the cow in question, or other cows of the same size in the herd, consume in one day. If this is not feasible, the amount of roughage consumed may be estimated by the following rule:

When both corn silage and dry roughage are fed, cows consume from $2\frac{1}{2}$ to 3 pounds of silage and from 0.6 to 1 pound of

good-quality hay daily per 100 pounds live weight. When dry roughage alone is fed, cows consume from 1.25 to 1.75 pounds good quality hay daily per 100 pounds live weight. Somewhat more legume hay than non-legume hay is usually consumed.

Since roughage is usually a more economical source of nutrients than are concentrates, as much should be fed as will be consumed without unnecessary waste. Let us assume that 36 pounds of silage and 12 pounds of alfalfa hay are being fed. The amounts of the nutrients in the silage and hay may be calculated from Table XXVII. The results are as follows:

	Digestible Protein, Pounds	Total Digestible Nutrients, Pounds
Corn silage, 36 lbs.....	.40	6.37
Alfalfa hay, 12 lbs.....	1.27	6.19
Total nutrients in roughage.....	1.67	12.56

To calculate the nutrients required in the concentrate mixture, subtract the amount of the nutrients supplied in the roughage from the total amount required, as follows:

	Digestible Protein, Pounds	Total Digestible Nutrients, Pounds
Total requirements.....	3.04	21.51
Supplied in roughage.....	1.67	12.56
To be supplied in concentrates.....	1.37	8.95

Thus, to balance the ration exactly, 8.95 pounds of total digestible nutrients will be required in concentrates, 1.37 pounds of which must be digestible protein.

Suppose that corn silage, alfalfa hay, corn, oats, and wheat bran are the only feeds available. A trial mixture may be calculated, and if it does not meet the requirements, the amounts may be reduced or increased as the case may be.

FIRST TRIAL CONCENTRATE MIXTURE

	Digestible Protein, Pounds	Total Digestible Nutrients, Pounds
Corn, ground, 4 lbs	.30	3.43
Oats, ground, 4 lbs	.39	2.82
Wheat bran, 4 lbs.....	.50	2.44
	—	—
Total nutrients in concentrates.....	1.19	8.69
Difference from requirements.....	— .18	— .26

This mixture fails to supply quite enough of the nutrients, especially protein. More bran may be added, since it is higher in protein than corn or oats, as follows:

SECOND TRIAL CONCENTRATE MIXTURE

	Digestible Protein, Pounds	Total Digestible Nutrients, Pounds
Corn, ground, 4 lbs.....	.30	3.43
Oats, ground, 4 lbs.....	.39	2.82
Wheat bran, 5 lbs.....	.63	3.05
	—	—
Total nutrients in concentrates.....	1.32	9.30
Difference from requirements.....	— .05	+ .35

The ration is now balanced closely enough for practical purposes.

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COMMUNITY STUDIES

During the winter feeding season, visit several dairy farmers who are willing to tell you how they feed their cows. By asking questions, and also by observing, obtain as much as possible of the information suggested by the following:

1. What kinds of roughages are fed?
2. Are the roughages home-grown or purchased?
3. How are the hay and silage carried from mow or silo to the cows?
4. How many times daily is each roughage fed and what is the total amount fed?
5. Are the silage and hay weighed or measured to each cow?
6. If the roughage is not completely consumed, what is the proportion left uneaten (e.g., soybean hay stems)?
7. What is done with the uneaten portion?
8. What kinds of concentrates are fed?
9. Are any of the concentrates raised on the farm?

10. Is feed ground and mixed on the farm?
11. What kind of an outfit is used for grinding?
12. How is the feed mixed?
13. What are the amounts of the feeds used in the mixture? Is salt or other mineral included?
14. What is the cost per ton of the mixture?
15. At what rate are the concentrates fed (pounds of concentrates to pounds of milk)?
16. If all of the concentrates are purchased as ready-mixed feed, what is the protein content of the feed?
17. What is the approximate cost per ton?

CHAPTER X

FEEDING THE DAIRY COW DURING THE PASTURE SEASON

Most dairymen feel that when cows are turned to pasture in the spring much responsibility as well as labor has been removed, and that from then on for a period of five or six months the cows can care for themselves so far as obtaining a supply of feed is concerned. This is often a serious mistake, for even though the pasture grass is tall and succulent, it may be so high in water content that the cows can not consume enough of it to supply their needs. Then, too, the decline in milk flow, which usually occurs when flies become numerous and is generally attributed to the annoyance of flies, is very often caused by the failure of the pasture to furnish sufficient feed.

Good pastures are usually the most economical sources of feed for dairy cattle, and for these reasons the summer feeding of dairy cattle is deserving of much more attention than usually is given it.

Operations:

1. Turning to pasture in spring.
2. Supplying concentrates as a supplement to pasture.
3. Feeding soiling crops as pasture supplements.
4. Using silage as a pasture supplement.
5. Feeding cows in summer without pasture.
6. Preventing bloat on pasture.
7. Selecting a pasture crop.

1. TURNING TO PASTURE IN SPRING

Care must be used in turning cows to pasture for the first time. The pasture crop may be so young that pasturing it too

early in the spring will seriously retard its growth during the summer. Digestive disturbances, bloat, and bad flavors in the milk may also result when care is not taken. Follow carefully the procedure outlined below:

Procedure:

- A. Examine the pasture crop to see that it is mature enough.
- B. Feed cows roughage before turning them to pasture.
- C. Turn cows to pasture, and watch them carefully.
- D. Remove cows from pasture.

A. Examine the pasture crop to see that it is mature enough.

—Before turning the cows to pasture in the spring, examine the



FIG. 67.—A GROUP OF AYRSHIRE COWS AT PASTURE IN OHIO

This rugged breed, developed in the highlands of Scotland, is fitted to make good use of rough pasture land.

grass or other pasture crop carefully in all parts of the pasture, to see whether it is sufficiently well advanced to furnish good feed without injury to the tender plants. Cattle should not be turned to pasture as soon as the plants begin to turn green, for such a practice usually results in stunting the growth of the

crop for several weeks and greatly reduces the yield during the season. Furthermore, the plants, when very short during early spring, are more subject to injury by tramping.

The pasture may be considered ready for cattle when the plants reach a height of 4 to 5 inches, or better 6 inches.

B. Feed cows roughage before turning them to pasture.—

Cows must be given a good fill of hay or other dry roughage, or even silage, with the usual amount of grain, just before they are turned to pasture for the first time. This greatly helps to prevent bloat, which often follows when cattle are turned on pastures wet from dew or rain, and also digestive disturbances due to the sudden change from dry feed to large amounts of very succulent feed. It also helps to prevent any undesirable effects on the flavor and composition of the milk.

Hence, feed the cows roughage and grain as usual in the morning before turning them to pasture. This procedure may be repeated for a day or two. In case the cows are being pastured on sweet clover or alfalfa, give them access to a rack in which a supply of straw or timothy hay is kept.

C. Turn cows to pasture, and watch them carefully.—Turn the cows to the pasture after they have had their feed of dry roughage or other feed as described above. Do not turn to pasture the first time when the plants are wet from dew or rain. There is some danger of bloat when cows are first pastured on legumes. Therefore, examine the cows every half hour for the first two hours for signs of bloat. Also, see that they do not exercise too severely by constant running about. If there is a tendency to this, drive the cows to the barnyard. (For special precautions against bloat, see page 290.)

D. Remove cows from pasture.—Cows should not be left on pasture all of the first day, as a rule. Milk production will be better maintained and there will be fewer disturbances if the cows are allowed to get only a good fill each day for the first day or two. Therefore, remove the cows from the pasture at the end of two hours or as soon as they seem satisfied. When this practice is followed, it is necessary, of course, to give the

usual morning feed each day before turning to pasture. After the first few days, leave the cows on pasture continuously, except during the milking hours.



FIG. 68.—USING WOODLAND TO GOOD ADVANTAGE

Much of the pasture used for dairy cattle can not be used to advantage for other purposes, therefore, a large proportion of the products obtained from the dairy herd in spring and summer comes from land that would probably yield little or no human food if dairy cattle were not kept.

These excellent Ayrshires are efficient converters of roughage into human food.

2. SUPPLYING CONCENTRATES AS A SUPPLEMENT TO PASTURE

Very young pasture grass usually contains so much water that a cow producing upwards of 25 pounds of milk daily can not consume enough of such grass to meet her needs, but must be given feed of some other sort. She will also need other feed when the pasture becomes short and dry in midsummer. Various supplements may be used. A concentrate mixture is most convenient and satisfactory from the labor standpoint, although when land and labor are available, hay, soiling crops, or silage may be more economical.

Procedure:

- A. Determine character of concentrate mixture necessary.
- B. Determine amount of concentrates necessary.
- C. Feed cows as individuals.

A. Determine character of concentrate mixture necessary.—

Very young grass contains much more protein than the same grass as it matures. The concentrate mixture suitable for use as a supplement to early spring pasture, therefore, need contain but a small proportion of protein, and so may be made up largely of low-protein farm feeds, such as corn and oats.

The composition at different stages of growth of a number of different pasture crops is given in Table X, together with references to suitable supplemental concentrate mixtures. Determine from this table which description most nearly fits your conditions, and select a suitable concentrate mixture from Class A, B, or C, of Table XI as directed in the table below.

TABLE X

CHANGES IN THE COMPOSITION OF PASTURE CROPS DURING GROWTH *

Feed	Dry Matter	Digestible Crude Protein	Total Digestible Nutrients	Ratio of Protein to Total Nutrients	Pasture Supplement
	%	%	Lbs.	1 :	Class
Kentucky bluegrass, before heading...	23.8	3.7	15.9	4.3	A
Kentucky bluegrass, headed out.....	36.4	2.8	21.1	7.5	B
Kentucky bluegrass, after bloom.....	43.6	1.9	25.4	13.4	C
Mixed grasses, immature.....	29.7	3.6	20.1	5.6	B
Mixed grasses, at haying stage.....	30.8	1.7	18.3	10.8	C
Rye fodder, 5 inches high.....	18.1	5.1	12.9	2.5	A
Rye fodder.....	21.3	2.1	15.4	7.3	B
Timothy, before bloom.....	24.2	1.8	16.5	9.2	B
Timothy, in bloom.....	32.1	1.3	18.8	14.5	C
Timothy, in seed.....	46.4	1.5	27.8	18.5	C
Alfalfa, before bloom.....	19.9	3.5	11.7	3.3	A
Alfalfa, in bloom.....	25.9	3.3	14.8	4.5	A
Alfalfa, after bloom.....	29.8	2.1	16.0	7.6	B
Sweet clover, before flower buds.....	15.5	2.8	.....	.....	A
Sweet clover, half in bloom.....	29.8	3.9	.....	.....	A
Sweet clover, seed ripening.....	52.2	6.7	.....	.....	B

* Sweet clover analyses from Ontario Dept. of Agr., Bul. 235. Other analyses from Henry and Morrison, *Feeds and Feeding*, 18th ed.

TABLE XI

CONCENTRATE MIXTURES FOR PASTURE SUPPLEMENTS

The following concentrate mixtures are to be used as supplements when the pasture is so abundant that it furnishes the cows with all the feed they care to consume.

Class A Mixtures

The concentrate mixtures in this class are to be used when the pasture grass furnishes a large amount of protein, that is, when it is young and green. See Table X. It is assumed that pasture grass of this kind will supply enough feed to produce 20 pounds of milk daily without the use of any supplement.

When the milk yield is more than 20 pounds daily, feed 1 pound of one of the following mixtures for each $2\frac{3}{4}$ pounds of milk (or 3.1 pounds for each gallon of milk) produced in excess of 20 pounds daily.

No. 1	No. 2
500 lbs. ground corn	600 lbs. ground corn
500 lbs. ground oats	200 lbs. ground oats
	200 lbs. wheat bran
1 qt. of mixture weighs 1 lb.	1 qt. of mixture weighs .9 lb.
No. 3	No. 4
900 lbs. hominy feed	700 lbs. ground barley
100 lbs. cottonseed meal	200 lbs. ground oats
	100 lbs. wheat bran
1 qt. of mixture weighs 1.1 lbs.	1 qt. of mixture weighs .9 lb.

Class B Mixtures

These concentrate mixtures are to be used when the pasture grass, though abundant in quantity, is quite low in protein, that is, when it is maturing, as indicated by B, Table X. It is assumed that pasture grass of this kind is sufficient for the production of 25 pounds of milk daily without the use of any supplement.

When the milk yield is more than 25 pounds daily, feed 1 pound of one of the following mixtures for each 2.5 pounds of milk (or 3.5 pounds for each gallon of milk) produced in excess of 25 pounds daily.

TABLE XI—*Continued***No. 5**

400 lbs. ground corn
400 lbs. ground oats
200 lbs. soybean oil meal

1 qt. of mixture weighs 1 lb.

No. 7

400 lbs. hominy feed
400 lbs. wheat bran
200 lbs. linseed oil meal

1 qt. of mixture weighs $\frac{3}{4}$ lb.

No. 6

300 lbs. ground corn
300 lbs. ground oats
250 lbs. wheat bran
150 lbs. choice cottonseed meal or
gluten meal

1 qt. of mixture weighs .8 lb.

No. 8

400 lbs. ground barley
400 lbs. wheat bran
200 lbs. ground soybeans

1 qt. of mixture weighs $\frac{3}{4}$ lb.

Class C Mixtures

These concentrate mixtures are to be used when the pasture grass is very low in protein, that is, when it has passed the blooming period and is becoming quite mature and dry, as indicated by C, Table X. It is assumed that the feed furnished by pasture of this kind is sufficient for the production of 10 pounds of milk daily.

When the milk yield is more than 10 pounds daily, feed 1 pound of one of the following mixtures for each $3\frac{1}{4}$ pounds of milk (or 2.6 pounds for each gallon of milk) produced in excess of 10 pounds daily.

No. 9

250 lbs. ground corn
250 lbs. wheat bran
250 lbs. gluten feed
250 lbs. soybean oil meal or cottonseed meal

1 qt. of mixture weighs 1 lb.

No. 11

200 lbs. hominy feed
400 lbs. wheat bran
200 lbs. linseed oil meal
200 lbs. gluten feed

1 qt. of mixture weighs $\frac{3}{4}$ lb.

No. 10

250 lbs. ground corn
150 lbs. ground oats
150 lbs. cottonseed meal
250 lbs. wheat bran
200 lbs. linseed oil meal

1 qt. of mixture weighs $\frac{7}{8}$ lb.

No. 12

300 lbs. ground barley
300 lbs. wheat bran
300 lbs. ground soybeans
100 lbs. cottonseed meal or gluten meal

1 qt. of mixture weighs .9 lb.

3. FEEDING SOILING CROPS AS PASTURE SUPPLEMENTS

Forage crops harvested and fed in fresh, green condition sometimes prove to be more economical supplements to pasture than do concentrates. The feeding of crops in this way is termed "soiling."

Procedure:

- A. Determine best stage to harvest.
- B. Harvest crop daily.
- C. Haul and feed crop to cows.

Equipment:

Mower or scythe, rake, fork, wagon or truck.

A. Determine best stage to harvest.—Examine frequently each crop being grown for soiling in order to determine its stage of growth. When the crop is cut at a very immature stage, the content of protein is high, but the yield of dry matter is much less than at maturity. When the crop is harvested while it is still green and succulent, the cows will consume more of it and leave less waste than when the plants begin to turn yellow and dry up. Therefore, plan the harvest period to provide as much green, succulent feed per acre as possible.

Should the next crop in the system be ready for harvest before the plot being harvested is entirely used, it may pay to change to the newer plot, harvesting and curing the remainder of the older plot for winter feeding. Thus, if, while a field of alfalfa is being fed, the corn crop becomes ready to harvest, begin feeding the corn, and cut and cure the balance of the alfalfa for hay.

B. Harvest crop daily.—Each day, harvest enough of the crop for one day's feed. This may be done by means of a team and mower, or scythe, or in the case of corn, by the use of a corn binder or corn knife.

Except, perhaps, in very cool weather, do not harvest more than the cows will consume without unnecessary waste during the day. This amount can be readily determined from a few days' observation. If more than this amount is harvested it is likely to "heat," or ferment, and lose much of its palatability.



FIG. 69.—SWEET CLOVER AS A PASTURE CROP

Sweet clover is becoming generally used as a pasture crop for dairy cattle. Seeded with small grain in the spring, it makes excellent pasture in late summer and fall, and the next spring produces earlier pasture than most other crops.

Rake, if necessary. Load on wagon or truck and haul to cows.

C. Haul and feed crop to cows.—Place feed in racks in the yard to which the cows have access; or better still, if the cows are kept in a barn, place the feed in mangers in the barn. There is usually less waste if only a part of the feed is given at one time,

for example, one-half of the feed in the morning immediately after cutting and the balance late in the afternoon, or the amount may be divided into three feeds a day.

4. USING SILAGE AS A PASTURE SUPPLEMENT

Silage has a number of advantages over soiling crops as a supplement to pasture. Chief among the advantages are the smaller amount of labor required daily during the summer in feeding the cows and the fact that the nutritive composition does not vary through the season as in the case of green crops. In feeding silage, follow the procedure outlined below:

Procedure:

- A. Open the silo.
- B. Remove silage daily and feed cows.
- C. Supply other feeds when necessary.
- D. Keep silage from spoiling.

Equipment:

- . Silage fork, silage cart or wagon, waterproofed canvas cover.

A. Open the silo.—If silage has not been removed from the silo for some time, or if a new silo is to be opened, remove the spoiled silage at the surface and load into a wagon or manure spreader. Spread this silage as fertilizer on a field to which livestock does not have access, as moldy silage may prove injurious.

B. Remove silage daily and feed cows.—Remove no more silage at one time than enough for one day's feeding, for silage spoils rapidly in hot weather. When pasture is good, one feeding of silage daily will probably be sufficient, but when pasture is scanty, give two feeds daily.

Silage is best fed in the barn after milking, although it may also be fed in racks in the yard. The amount of silage to be

given at each feed should be about the same as under winter feeding conditions, as discussed in Chapter IX.

C. Supply other feeds when necessary.—Silage is so low in protein that when the pasture is scanty it is necessary to supply legume hay or concentrates to furnish sufficient protein. In such a case, feed as much legume hay as the cows will consume readily, or supply a concentrate mixture like those given under Class B, Table XI.

As a guide to the kind and amount of feed to give, watch the cows' appetites, milk production, and physical condition.



FIG. 70.—FEEDING ALFALFA HAY TO COWS AT PASTURE

If cows are to maintain their milk production and body weights when the pastures become short, they must be given additional feeds.

If the cows eat up all their feed quickly, it usually means that they are not getting enough. The record of milk production is the best guide, but the condition of the cows must also be watched, for it does not pay to permit the cows to become very thin in flesh.

D. Keep silage from spoiling.—Remove daily, if possible, a layer at least 2 inches deep over the entire surface of the silo. If the silo is so large that this would provide too much silage for one day's feeding, remove each day silage from only one-half the surface of the silo, and keep a waterproofed canvas

cover over the other half. Lay this cover closely over the silage so as to exclude the air. If necessary, the cover may be weighted down by putting a little silage on it. To waterproof the canvas, paint with melted paraffine.

5. FEEDING COWS IN SUMMER WITHOUT PASTURE

Some herds of dairy cows are not pastured throughout the summer, but are fed rations of roughage and concentrates just as in winter, or are fed soiling crops without concentrates.

Procedure:

- A. Provide roughage and concentrates.
- B. Provide and use complete soiling system.

Equipment:

Same as given under "Feeding the Dairy Cow in Winter," Chapter IX, and under Section 3, "Feeding Soiling Crops," above.

A. Provide roughage and concentrates.—The feed required in summer without pasture or soiling crops is essentially the same as during the winter season. For directions for feeding to meet these conditions, see Chapter IX.

B. Provide and use complete soiling system.—In feeding the herd under this plan, follow in general the directions given under Section 3, "Feeding Soiling Crops as Pasture Supplements;" but instead of providing only part of the feed in the form of soiling crops, provide all the crops the cows will consume without undue waste. Feed the cows at least twice, or better three times, daily.

6. PREVENTING BLOAT ON PASTURE

The bloating of cattle when on pasture is one of the drawbacks to the pasture method of feeding, as occasionally serious

losses result from this cause. To guard against bloat, the following precautions should be taken:

Procedure:

- A. Provide dry feed before turning to pasture.
- B. Keep off pasture when plants are wet.
- C. Use caution in pasturing after frosts.
- D. Treat the cases of bloat that occur.



FIG. 71.—COWS IN SWEET CLOVER PASTURE

Contrast this picture with Fig. 72. Sweet clover furnishes a large amount of feed during hot, dry weather when most nonlegume pastures, such as bluegrass, timothy, and redtop, are bare.

Equipment:

Feed rack in yard, a supply of hay or straw.

A. Provide dry feed before turning to pasture.—During the first three or four days the cows are pastured in the spring, give them a full feed of hay, straw, or other dry feed in the morning before turning them to pasture. If sweet clover or alfalfa is being pastured, provide a constant supply of dry straw in a feed rack to which the cows have access. Such a practice seems to reduce greatly the number of cases of bloat.

B. Keep off pasture when plants are wet.—Do not turn cows to pasture the first time when the plants are wet from dew or rain. After they are once accustomed to the pasture, leave them on continuously except at milking times. In case some cows seem especially subject to bloat, it may be best to keep them off legume pastures whenever the plants are wet, although supplying dry feed constantly will often prevent the trouble.



FIG. 72.—THESE COWS HAVE NO TIME TO LOOK AT THE PHOTOGRAPHER

When pastures are short, cows must keep busy many hours trying to gather enough feed. Often it is impossible for a cow to graze over sufficient acreage in one day to give her sufficient nutriment. Besides time to secure her feed, a cow must have time to lie down and masticate the feed, that is, "chew the cud." Much feed in addition to pasture is needed to keep cows in as good condition as the ones shown in this picture.

C. Use caution in pasturing after frosts.—Legume pastures, such as alfalfa and sweet clover, seem to cause bloat more frequently after frosts in the fall. When pasturing under these conditions, watch cattle carefully. It may be necessary to take them off such pasture unless favorable weather brings new growth.

D. Treat the cases of bloat that occur.—For directions, see Chapter XV.

7. SELECTING A PASTURE CROP

There are wide differences in the value of different kinds of pasture crops. Some crops produce a much greater and more constant supply of feed during the summer season than others. In selecting the most desirable crop for pasture, it must also be remembered that some crops are of much greater help than others in maintaining the fertility of the soil.

Procedure :

A. Choose pasture crop best adapted to prevailing conditions.

B. Select pasture crop best conserving soil fertility.

A. Choose pasture crop best adapted to prevailing conditions.—Study Chapter II of “Crop Production and Soil Management,” by Cox. Note the statements regarding the relation of climatic and soil conditions to the successful growing of crops, particularly the grasses and legumes. Read also Chapter VI, “Pastures and Pasturage,” in Piper’s “Forage Plants and their Culture.” With the aid of this information, choose pasture crops that seem suitable for your conditions. Before deciding definitely, however, examine the forage growing in the pastures in your neighborhood. If a certain crop is growing well in pastures near your farm, it is likely that you also can grow it. On the other hand, if a certain crop, for example, sweet clover, is not found in your neighborhood, its absence is not evidence that it can not be grown on your farm.

B. Select pasture crop best conserving soil fertility.—Take the list of selected crops just prepared and study it further with reference to the information on the relation of crops to soil fertility given in Chapter VII of Cox’s “Crop Production and Soil Management.” Make a final choice of the most desirable crop or crops. Before proceeding to the sowing of the seed, study Chapter XXX, “Growing Grasses for Hay and Pasture,” in Cox’s text.

REFERENCES

Most of the references given at the end of Chapter IX apply to this chapter also.

COMMUNITY STUDIES

Visit a number of dairy farms in your locality during the pasture season, and study the practice on these farms with respect to the following:

1. What kinds of grasses or crops are used for pasture?
2. How tall is the grass when the dairy cows are first turned to pasture?
3. Are cows fed in the barn in the morning before they are first turned to pasture? If so, is this done more than one day?
4. What feeds are given just before the cows are turned to pasture?
5. Is any dry roughage provided in addition to pasture during early spring?
6. Are any concentrates fed when the pasture is "good"? If so, what is the mixture used, and at what rate is it fed?
7. Have any cases of bloat occurred while the cows were on pasture?
8. How are cases of bloat treated?
9. Are any precautions taken to prevent bloat?
10. Are supplements to pasture supplied when pasture becomes dry or scanty? If so, of what kind? (Concentrates, soiling crops, silage, hay?)
11. If concentrates are fed, learn—
 - (a) The proportions of the feeds in the mixture.
 - (b) How often concentrates are fed.
 - (c) The rate at which the concentrates are fed.
 - (d) Number of weeks during the pasture season when such feeding is done.
12. If soiling crops are used as supplement to pasture, learn—
 - (a) The kind of crops used.
 - (b) How the crops are harvested and how often.
 - (c) Where the crops are fed (barn, yard, or pasture).
 - (d) Whether the feeding of these crops has caused bloating.
 - (e) What quantity of each crop is fed daily.
 - (f) The amount of land required to furnish the soiling crops for the herd; for one cow.
13. When corn silage is used as supplement to pasture, find—
 - (a) Whether silage is the only supplement used, or whether hay or concentrates are fed in addition.

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- (b) Whether a separate silo for summer feeding is used, and if so, its diameter compared with that of the silo used for winter feeding.
 - (c) The amount of silage fed per cow per day.
 - (d) The number of times daily the cows are fed silage.
 - (e) The method used to keep silage from spoiling.
14. If hay is used as a supplement to pasture, ascertain—
- (a) The kind of hay fed.
 - (b) The number of times it is fed daily and the amount.
 - (c) Where the hay is fed.
 - (d) Whether hay is consumed in sufficient amounts to keep the milk flow up to the expected level.

CHAPTER XI

REARING THE DAIRY CALF

There is no more important detail in the care and management of a dairy herd than the rearing of the calves. Well-grown, vigorous animals are usually those that have had excellent care from birth. Undernourished, stunted calves often, although not always, may be grown out into large animals by careful feeding; but calves that are thrifty, vigorous, and large when six months of age are much more resistant to disease and have a much better opportunity to develop into large, useful animals. Undersized calves may be due to false ideas of economy on the part of the feeder, as well as to a lack of knowledge of the principles and practices of successful calf raising

Operations:

1. Caring for the calf at birth.
2. Teaching the calf to drink.
3. Feeding the milk often.
4. Feeding the milk warm.
5. Substituting skim milk for whole milk.
6. Raising calves on limited amount of whole milk.
7. Feeding dried or powdered skim milk.
8. Feeding proprietary and home-mixed calf meals.
9. Keeping utensils clean.
10. Feeding concentrates.
11. Feeding hay or other dry roughage.
12. Feeding silage.
13. Feeding after discontinuing milk.
14. Pasturing calves.
15. Preventing growth of horns.
16. Marking calves for identification.

1. CARING FOR THE CALF AT BIRTH

Too often, the calf is left to shift for itself at the most critical period of its life. Lack of care during the first few days usually means the loss of a large number of calves that might easily have been saved.

Procedure:

- A. Provide good quarters to receive the calf.
- B. Keep the calf warm.
- C. Assist the calf in nursing, if necessary.
- D. Disinfect the calf's navel.

Equipment:

Fork, shovel, broom, air-slaked lime or disinfectant solution, tincture of iodine solution, cup, sprinkling can, blanket or gunny sacks.

A. Provide good quarters to receive the calf.—Watch the breeding records of the herd in order to know when calves may be expected to be born. Prepare a box stall a day or two in advance. Clean the stall thoroughly, removing all bedding, and scraping and sweeping down the sides of the stall if manure or filth has gathered on them. If any calves having white scours have been in the stall previously, disinfect the stall thoroughly, using a 5 per cent solution of carbolic acid or coal-tar disinfectant. Sprinkle the disinfectant on the walls and floors. In case the stall has a dirt floor, or if the weather is so cold that the stall would not dry, a liberal amount of air-slaked lime may be used instead.

After the stall has dried, place a large amount of clean, dry bedding in it. Keep the stall well bedded and as dry as possible. Avoid drafts so far as possible, although fresh air is desirable.

Calves born in the summer time do not require such close attention as those born during cold weather. Calves born at

pasture during warm weather usually require less attention than those born in the barn, although if the weather is rainy or cold there is danger of infection or chilling.

B. Keep the calf warm.—Be sure that the calf is dry and warm. If it shivers, cover it with a blanket or a number of gunny sacks. Provide an abundance of dry bedding.

C. Assist the calf in nursing, if necessary.—In case the calf is unable to stand and nurse its mother, give it some assistance. Sometimes two persons are necessary if the calf is very weak. Make certain that the calf receives some of the first milk, or colostrum. It should have an opportunity to nurse four or five times during the first day.

D. Disinfect the calf's navel.—As soon as possible after the calf has been given the first attention necessary, disinfect the navel. Paint the raw, exposed part of the navel cord with tincture of iodine, using a small brush or piece of cheese cloth. In case iodine is not available, use a 5 to 10 per cent solution of a coal tar disinfectant, placing this in a cup and holding the cup up under the calf so that the navel cord is immersed in the solution. Repeat the treatment daily until the cord becomes dry.

The disinfection of the navel is very essential as it helps to prevent disease germs from entering the body of the calf at that point.

2. TEACHING THE CALF TO DRINK

This is an operation that requires considerable patience, as some calves are slow in learning to take milk from a pail.

Procedure:

- A. Separate calf from its mother.
- B. Provide milk from the calf's mother.
- C. Use patience in teaching calf.

A. Separate calf from its mother.—When the calf is one or two days of age, place it in a pen where it will not have access

to any cow. Calves that are very weak may have to be left with their mothers for three days or even more, but strong, vigorous calves may usually be separated from their mothers at twenty-four to thirty-six hours of age. If they remain with their mothers longer than this, there is danger of their obtaining so much milk that indigestion results. Also they are more readily taught to drink if separated at an early age.



FIG. 73.—GIVING BOTH THE FUTURE DAIRYMAN AND THE FUTURE COW A
GOOD START

There is nothing that will give a boy a greater interest in farm life than to permit him to raise a good animal for his very own.

B. Provide milk from the calf's mother.—Use milk from the mother of the calf for feeding during the first few days, unless the milk is not suitable on account of its being thick, stringy, or too rich. Milk that is rich in fat, such as Jersey and Guernsey milk, sometimes causes digestive disturbances. If this occurs, dilute the rich milk with skim milk, using one part of skim milk

to two parts of whole milk. In the absence of skim milk, use warm water in the same proportions. After the calf is five to seven days old, milk from the herd may be substituted for the mother's milk.

C. Use patience in teaching calf.—Pour about a quart of the mother's milk into a clean pail used for feeding calves, keeping account of the amount. Back the calf into a corner, and bring its nose into contact with the milk. This is best accomplished by allowing the calf to suck the fingers of the feeder so that the head may be guided into the pail. After the calf has obtained a few mouthfuls of milk, remove the fingers, although whenever the calf lifts its head out of the pail it is necessary to repeat the procedure. When the calf has consumed the amount of milk first offered, pour in the rest of the milk that is to be given at that feeding. See Tables XII and XIII for information on the amounts of milk to be fed.

Use as much patience as possible, for the calf may choke if its nose be forced into the milk. It is sometimes necessary to omit a feeding before the calf can be taught to drink.

3. FEEDING THE MILK OFTEN

In feeding the calf, it must be borne in mind that the digestive system of a very young animal can not assimilate a large amount of food at one time.

Procedure:

- A. Determine amount of milk to be fed.
- B. Save milk for several feedings.

A. Determine amount of milk to be fed.—Study the feeding charts in Tables XII and XIII on the two following pages, and determine the amount of milk which should be fed daily. Plan to feed the calf three or four times daily, at as nearly equal intervals as possible, as there is less danger of indigestion when the daily allowance of milk is fed in small quantities at short intervals.

TABLE XII

MILK-FEEDING SCHEDULE FOR RAISING CALVES ON WHOLE MILK FOLLOWED BY SKIM MILK

(Concentrates and Hay to Be Fed in Addition)

Age of Calf, Days	Larger Breeds (Holstein, Brown Swiss, Ayrshire)				Smaller Breeds (Jersey, Guernsey)			
	Amount of milk				Amount of milk			
	Whole, per day, pounds	Skim, per day, pounds	Total per period		Whole, per day, pounds	Skim, per day, pounds	Total for period	
			Whole, pounds	Skim, pounds			Whole, pounds	Skim, pounds
1	With mother				With mother			
2	8		8		6		6	
3-20	10		180		7		126	
21	9	2	9	2	6	2	6	2
22	8	3	8	3	6	2	6	2
23	7	4	7	4	5	3	5	3
24	6	5	6	5	5	3	5	3
25	5	6	5	6	4	4	4	4
26	4	7	4	7	4	4	4	4
27	3	8	3	8	3	5	3	5
28	2	10	2	10	3	6	3	6
29	1	11	1	11	2	7	2	7
30	0	12	0	12	2	7	2	7
31	0	12	0	12	1	8	1	8
32-35	0	12	0	48	0	9	0	36
36-48	0	13	0	182	0	10	0	140
49-63	0	14	0	196	0	11	0	154
64-182	0	15	0	1785	0	12	0	1428
Totals			233	2291			173	1809

B. Save milk for several feedings.—At milking time feed the calf fresh mother's milk or mixed milk from the herd. At the same time save out enough milk for the other feedings during the day.

TABLE XIII

MILK-FEEDING SCHEDULE FOR RAISING CALVES ON MINIMUM AMOUNTS OF WHOLE MILK WITH CONCENTRATES AND HAY AS THE ONLY SUPPLEMENTS

Age of Calf, Days	Larger Breeds (Holsteins, Brown Swiss, Ayrshires)		Smaller Breeds (Jerseys and Guernseys)	
	Amount of milk		Amount of milk	
	Daily, Pounds	Total for period, pounds	Daily, pounds	Total for period, pounds
1	With mother	.....	With mother	
2	6	6	4	4
3- 21	10	190	6	114
22-35	8	112	7	98
36-42	6	42	6	42
43-49	4	28	5	35
50-56	2	14	5	35
57-60	2	8	4	16
61-70	.....	.....	4	40
71-78	.....	.....	2	16
Totals. ....	.....	400	.....	400

4. FEEDING THE MILK WARM

It is important that the milk given to a calf be in good condition and at the proper temperature.

Procedure:

- A. Feed milk immediately after it is drawn.
- B. At other times warm milk to body temperature.
- C. Keep milk in good condition.

Equipment:

Clean pails, cooling tank, hot water or steam, thermometer.

A. Feed milk immediately after it is drawn.—Feed the very young calf at once after securing the milk from its mother, when

the milk will be at about body temperature. Milk cools rapidly in winter and if fed when cold may cause indigestion, especially if the milk is cold at one feeding and warm at another.

B. At other times, warm milk to body temperature.—Be careful to warm the milk that has been saved for the feedings between milkings to about body temperature (100° F.). To warm the milk, place it in an 8- or 10-quart pail. Set this pail into a larger pail containing 3 to 4 quarts of hot water. If steam is available, turn the steam into the water surrounding the pail of milk. If neither steam nor hot water is available, place the pail containing the milk on a stove, stirring the milk constantly until it reaches the desired temperature. Use a thermometer, preferably of the floating type, if available. It is not advisable to heat the milk by turning steam or hot water into it, as this dilutes the milk too much.

C. Keep milk in good condition.—Place the milk that has been saved for the other feedings in a can; and set in a cooling tank. This is necessary in summer to prevent souring, and in winter to prevent freezing. Keep the can covered to prevent flies and dust from getting into the milk. It is best not to feed sour milk to very young calves, although this often may be done successfully with calves five to six months of age. Try to have the milk that is to be fed to very young calves in the best possible condition.

5. SUBSTITUTING SKIM MILK FOR WHOLE MILK

In some of the best purebred dairy herds, it is the practice to feed whole milk to calves until they are six months or more of age. Whole milk is, of course, the best feed for calves, as it induces rapid gains, and the calves that receive it keep in a healthy, sleek condition, being at the same time less subject to digestive troubles. In most dairy herds, however, this method of raising calves is too expensive, and skim milk, alone or with calf meals, is used to take the place of the whole milk, and concentrates are fed to supply energy equivalent to that in the butterfat.

Another plan is to feed the calves on a limited amount of whole milk until they are two and one-half months of age, at the same time inducing them to eat as much grain and hay as possible.

Procedure:

- A. Secure supply of skim milk.
- B. Make substitution gradually.
- C. Stanchion calves at feeding time.
- D. Remove foam from milk before feeding.
- E. Continue skim milk feeding as long as practical

A. Secure supply of skim milk.—If a cream separator forms part of the farm equipment, separate some milk at each milking and feed the skim milk fresh to the calves. Separate the milk as soon as possible after it is drawn from the cows, so that it will not be necessary to heat it. Should the milk become cold before being fed, heat it to about body temperature. In cold weather, warm the bowl of the separator by running two or three quarts of hot water through it, before beginning to separate the cream.

When a cream separator can not be used on the farm, skim milk may sometimes be purchased from a creamery. Such milk should be thoroughly pasteurized at the creamery in order to prevent the transmission of disease germs. In case it has not been pasteurized, it can be made safe for feeding by heating to the boiling point, or by holding at a temperature of 150° F. for thirty minutes.

B. Make substitution gradually.—Begin substitution of skim milk for whole milk when calves are about three weeks old. Calves that are below normal in size or vigor should receive whole milk somewhat longer. Make the substitution a gradual one. For example, suppose 5 pounds of whole milk is being fed each calf at each feeding time. The first day skim milk is used, mix 1 pound of skim milk with 4 pounds of whole milk at a feeding. The second day use the same proportions. The third and fourth days, use 2 pounds of skim milk to 3 pounds of whole milk, and so on until substitution is complete.

The age at which skim milk feeding should begin depends somewhat upon the amount of concentrates and hay being consumed. The concentrates take the place of the butterfat of the whole milk; therefore, if the calves are not eating concentrates in liberal amounts, the beginning of skim milk feeding must be delayed until they do eat them.

C. Stanchion calves at feeding time.—If more than one calf is kept in a pen, provide individual stanchions and mangers.



FIG. 74.—BARN FOR YOUNG STOCK, FITTED WITH STEEL STALLS AND STANCHIONS

Each calf may be stanchioned at feeding time. The wooden manger partitions prevent the calves from sucking each other and also insure each calf's getting its portion of feed so that accurate feed records may be kept. The pens may be cleaned with the aid of a litter carrier on a track near the wall.

Fasten calves in stanchions before feeding them milk, and keep them stanchioned until after they have been fed some concentrates. This plan helps to prevent the calves from spilling the milk and also from sucking each other.

D. Remove foam from milk before feeding.—Whenever there is a large amount of foam on the skim milk, it should be removed by drawing a paddle or small board across the surface

of the milk, or else held back with a piece of cheesecloth while the milk is slowly poured into the pails for feeding. Foam is objectionable in that it causes calves to take too much air into their stomachs, resulting in bloating.

E. Continue skim milk feeding as long as practical.—Continue to feed skim milk until the calves are six months of age, or better still, one year of age, if possible. In some cases, however, the milk is too valuable to be used for feeding purposes except during the first three to four months when milk is essential in giving the calves a good start. Consult Table XII for the amounts of skim milk to be fed daily.

6. RAISING CALVES ON A LIMITED AMOUNT OF WHOLE MILK

The following directions apply to conditions where skim milk is not available and whole milk must be used sparingly.

Procedure:

- A. Feed calves liberally at start.
- B. Encourage calves to eat other feeds.
- C. Follow definite schedule in feeding milk.

A. Feed calves liberally at start.—Feed liberal amounts of whole milk to the calves until they are four weeks of age, but do not feed more than they can use to advantage. About 1 pound of milk per day for each 10 pounds of live weight is a good rule to follow.

B. Encourage calves to eat other feeds.—During this period use every effort to encourage the calves to eat concentrates and legume hay in large amounts. The more of these they eat, the less will be the total amount of milk required. Keep a supply of concentrates of different kinds, such as wheat bran, ground oats, linseed oil meal and ground corn separately, if possible, or else mixed—where the calves have constant access to them. Provide fine-stemmed, leafy clover, alfalfa, or other legume hay, and put a fresh supply in the rack whenever the finer parts have been eaten. The success of this plan of raising

calves on a small amount of milk depends upon getting them to eat large amounts of the other feeds.

C. Follow definite schedule in feeding milk.—Consult the feeding schedules in Table XII and arrange in advance a complete milk-feeding schedule for each calf, such as the one shown in part below.

TABLE XIV
POUNDS OF WHOLE MILK TO BE GIVEN AT EACH FEEDING

Date	Calf No. 1	Calf No. 2	Calf No. 3
January 12.....	5	4	2
January 13.....	5	4	1
January 14.....	4	3	1
January 15.....	4	3	1
January 16.....	4	3	1
January 17.....	4	3	1
January 18.....	4	3	1
January 19.....	4	3	1
January 20.....	4	3	0
January 21.....	3	2	0

Post this chart near the balance where the milk is weighed at feeding time.

In case a calf has digestive troubles, fails to eat enough of the other feeds to make good gains, or for any reason appears unthrifty, increase the amount of milk for a time or do not reduce it as fast as the schedule calls for, as seems best to meet the needs of the case.

7. FEEDING DRIED OR POWDERED SKIM MILK

Dried, or powdered skim milk can sometimes be secured at such a price that it can be fed economically. A second grade of the dried milk is generally used for this purpose.

Procedure:

- A. Prepare definite schedule for each calf.
- B. Prepare milk for feeding.
- C. Feed in same manner as separator milk.

Equipment:

Clean pails, milk can, skim milk powder, scales, hot water, stirring rod, feeding charts.

A. Prepare definite schedule for each calf.—Consult the directions for feeding skim milk and prepare a daily feeding chart for each calf, setting down opposite each date the amount of skim milk to be given at each feeding. The same directions as to the amounts of skim milk to be fed apply to the dried milk after it has been prepared for feeding.

B. Prepare milk for feeding.—Calculate from the feeding charts that have been prepared the amount of the skim milk required for all the calves at each feeding. Weigh out one-tenth this amount of dried milk into a pail. If there are any lumps in the powder, rub them through a fine sieve. Add an equal weight of hot water and stir the milk for a few minutes to dissolve as much of it as possible. Now pour into a milk can or other sufficiently large container, and add eight times as much warm water by weight as the dried milk weighed out. This will bring the weight of the mixture up to ten times the amount of the dried milk, which is similar to the concentration of separator skim milk. Stir the mixture thoroughly. The water should be warm enough to bring the final mixture to about body temperature.

C. Feed in same manner as separator milk.—Feed the skim milk prepared from the dried milk in the same manner and in the same amounts as ordinary separator skim milk.

8. FEEDING PROPRIETARY AND HOME-MIXED CALF MEALS

It is often stated that milk is too expensive to feed to calves except in very limited amounts, and attempts are made to raise calves on so-called "milk substitutes." Investigations have shown that there are no complete substitutes for milk for very young calves, as explained on pages 219–221. The following directions have been formulated to provide a

reliable guide for the feeding of calf meals, and if carefully followed they should bring a considerable degree of success.

Procedure:

- A. Secure supply of calf meal.
- B. Prepare feeding schedule for each calf.
- C. Feed only amounts required.
- D. Use care in mixing and feeding meal.
- E. In case of indigestion, feed milk only.
- F. Continue milk feeding to two months of age.

A. Secure supply of calf meal.—The proprietary or ready-mixed calf meals may be purchased on the market. Directions for feeding usually accompany each package. It has been found, however, that these directions usually call for the use of too little milk to grow strong, vigorous calves. It is believed that the suggestions given in the following sections, if carefully followed, will help overcome this difficulty and yet not make the cost of feeding too great.

Home-mixed calf meals have also been used with some success as substitutes for part of the skim milk usually fed. The cost of these meals is usually less than that of the proprietary meals.

To make a home-mixed calf meal, secure the materials and mix together according to one of the following formulas:

No. 1

Ground corn, 67 lbs.
Dried blood, 25 lbs.
Linseed oil meal, 8 lbs.

No. 2

Hominy feed, 25 lbs.
Linseed oil meal, 25 lbs.
Red dog flour, 25 lbs.
Dried blood, 25 lbs.

No. 3

Skim milk powder, 20 lbs.
Dried blood, 10 lbs.
Corn starch, 20 lbs.
Flour middlings, 20 lbs.
Ground rolled oats, 20 lbs.
Ground flaxseed, 10 lbs.

No. 4

Ground oat flakes, 45 lbs.
Ground flax seed, 20 lbs.
Flour middlings, 10 lbs.
Ground corn, 22 lbs.
Dried blood, 3 lbs.

Use only good-quality materials, grind finely, and store in a dry place.

B. Prepare feeding schedule for each calf.—It is essential that each calf be fed carefully measured amounts of feed, since irregular amounts may cause indigestion. Therefore, as soon as it is decided to raise a calf, rather than to sell it for veal, make out a complete feeding schedule, such as the one shown in Table XV. This schedule should be carefully followed unless it is found that either more or less should be fed to give best results, or unless indigestion occurs, as discussed below.

TABLE XV

SAMPLE DAILY FEEDING SCHEDULE FOR RAISING CALVES ON MILK AND CALF MEAL

(One-half of the Amounts Shown to Be Given at Each Feeding)

Date	Age of Calf, Days	Calf No. 1 (Holstein)			Calf No. 2 (Jersey)		
		Whole milk pounds	Skim milk pounds	Calf meal, table-spoonfuls	Whole milk, pounds	Skim milk, pounds	Calf meal, table-spoonfuls
Jan. 11.....	20	10	0	0	7	0	0
Jan. 12.....	21	9	2	2	6	2	2
Jan. 13.....	22	8	3	2	6	2	2
Jan. 14.....	23	7	4	2	5	3	2
Jan. 15.....	24	6	5	2	5	3	2
Jan. 16.....	25	5	6	2	4	4	2
Jan. 17.....	26	4	7	2	4	4	2
Jan. 18.....	27	3	8	2	3	5	2
Jan. 19.....	28	2	10	2	3	6	2
Jan. 20.....	29	1	11	2	2	7	2
Jan. 21.....	30	0	12	2	2	7	2
Jan. 22.....	31	.....	12	2	1	8	2
Jan. 23-26.....	32-35	.....	12	2	0	9	2
		Ounces			Ounces		
Jan. 27-Feb. 2...	36-42	.....	10	6	.....	8	4
Feb. 3-9.....	43-49	.....	8	10	.....	7	6
Feb. 10-16.....	50-56	.....	6	14	.....	6	8
Feb. 17-23.....	57-63	.....	4	18	.....	4	12
Feb. 24-Mar. 2...	64-70	.....	2	22	.....	2	16
Mar. 3-June 21..	71-182	.....	0	24	.....	0	20

The amounts of milk for the first seven weeks as shown in Table XV are the same as those shown in Table XII, which is planned for calves of average size for their respective breeds. A more exact schedule could be made out by weighing each calf each week, feeding the milk at the rate of 1 pound daily for each 10 pounds of live weight. One pound of the calf-meal gruel may be considered equivalent to 1 pound of skim milk.

C. Feed only amounts required.—Follow the directions carefully so that the calves will receive enough nourishment and yet not suffer from indigestion from overfeeding. The amounts of calf meal required are about as follows:

From twenty-one days to thirty-five days of age, 1 tablespoonful (about 1 ounce) of calf meal at each of two feedings daily, the dry meal being placed in the milk.

From thirty-six to seventy days of age the amount of calf meal may be increased and the skim milk decreased. During this period the meal should be first mixed with water to form a gruel, as described in the following section. Two ounces of calf meal when mixed with 16 ounces of water may replace 1 pound of skim milk.

After seventy days of age, 24 ounces of calf meal per head daily for the larger breeds, and 20 ounces for the smaller breeds, is sufficient. Somewhat larger amounts may safely be fed as the calves increase in size.

Calf meal may be fed dry as part of the concentrate mixture, such feeding being begun as soon as the calves will eat concentrates. A suitable mixture may be made by combining ground corn, ground oats, wheat bran, and calf meal in equal parts by weight.

D. Use care in mixing and feeding meal.—As directed above, the dry calf meal may be placed in the milk until the calf reaches the age of five weeks. Since the amount of milk is decreased and the calf meal increased beginning with the sixth week, the calf meal should be mixed with water before being added to the milk. The treatment with water helps make the meal more

digestible and the water is also necessary to provide the calf with a sufficient amount.

To prepare the calf meal for feeding, mix it with boiling hot water at the rate of 1 ounce of meal to 8 ounces of water. Stir thoroughly and let stand for eight to ten hours before feeding. Cooking in a fireless cooker for eight to ten hours has been recommended. If hot water is not available, cold water may be used instead, although the results obtained may not be quite so good. In any case, the calf-meal gruel and milk mixture or calf-meal gruel alone should be fed at body temperature.

E. In case of indigestion, feed milk only.—Indigestion quite frequently occurs when calves are fed too large amounts of calf meal, or when the gruel or milk is fed at varying temperatures or in irregular amounts. If such difficulty is experienced, feed the calf milk only for a few days until the trouble disappears. Gradually return to the regular schedule.

F. Continue milk feeding to two months of age.—Milk is often fed in smaller quantities and calf meal in larger quantities than here recommended, but calf raising seldom proves successful unless milk feeding is continued until the calf is at least two months of age.

9. KEEPING UTENSILS CLEAN

While cleanliness is necessary in all feeding operations, it is especially important in the feeding of young animals, which are always more susceptible to infection than older ones.

Procedure:

- A. Use separate pails for feeding calves.
- B. Wash and sterilize pails and other utensils.

A. Use separate pails for feeding calves.—Keep a separate set of pails for use in feeding the calves. Ten-quart galvanized iron pails with iron handles are suitable for this purpose, as they are light in weight and can be readily nested.

B. Wash and sterilize pails and other utensils.—Each day the cream separator, all pails, dippers, cans, etc., should be washed, steamed or scalded with boiling water, drained, and placed so that the sun can shine into them, as explained in Chapter VII. It is very essential that the utensils used in feeding the calves be kept clean, for dirty pails are very often the cause of indigestion and other calf ailments, and may carry disease from one calf to another.

10. FEEDING CONCENTRATES

If properly chosen and prepared, concentrates may be fed quite freely to very young calves.

Procedure:

- A. Provide concentrates at an early age.
- B. Provide finely ground concentrates for young calves.
- C. Feed concentrates liberally.

A. Provide concentrates at an early age.—Begin feeding concentrates as soon as the calves will eat them, which will probably be when they are seven to fifteen days of age. It is usually necessary to coax the calves in the beginning in order to get them accustomed to the feed. To do this, place a small handful of the concentrate mixture used, or ground oats, ground corn, or linseed oil meal, in the pail as the calf is finishing its milk, or offer a little in the hand immediately after feeding milk.

Concentrates such as blood meal and flaxseed meal are sometimes the first ones used. These are fed in the milk at the rate of 1 to 2 tablespoonfuls at a feeding, depending upon the size of the calf. They often aid in giving the calves a liking for concentrates, and may also act as correctives for an over-laxative condition.

B. Provide finely ground concentrates for young calves.—Use only finely ground concentrates for calves less than three

months of age. Very young calves can not chew hard grains to advantage, and much prefer the softer feeds. After they are three months of age, they may be fed whole grains, such as corn and oats.

C. Feed concentrates liberally.—Provide large amounts of concentrates so that the calves may grow rapidly. This is especially important if skim milk is fed at an early age. The concentrates may be weighed or measured twice daily and placed in a box or manger to which the calf has access, or a constant supply of the concentrates may be kept before the calves, as in the “self-feeder” plan.

11. FEEDING HAY OR OTHER DRY ROUGHAGE

The principal roughage fed to calves should be good legume hay, such as clover or alfalfa.

Procedure:

A. Provide fine-quality legume hay.

B. Use other roughages only as supplement.

A. Provide fine-quality legume hay.—Place some fine-stemmed, leafy legume hay, such as clover or alfalfa, in a rack so that the calves may have access to it from the time they are ten to fourteen days old. Calves often begin to nibble at the hay when very young, and learn to eat roughage readily. Replace the hay with a fresh supply every two or three days, or whenever the finer parts of the hay have been consumed. The part refused by the calves may be fed to the older animals in the herd.

B. Use other roughages only as supplement.—Other roughages, such as non-legume hay, corn stover, etc., are suitable only as supplements to legume hay and not as the only roughages fed, if good results are to be expected. Such roughages may be fed in a separate rack, so that the calves have access to both legume and non-legume roughage at the same time. In the case of

calves several months old, one feed of legume hay and one of non-legume roughage may be given daily.

12. FEEDING SILAGE

Certain precautions must be observed in feeding silage to calves. If fed too early or too freely it may prove harmful.

Procedure:

- A. Feed silage to calves over three months of age.
- B. Feed silage in limited amounts.
- C. Use only good silage.

A. Feed silage to calves over three months of age.—When silage is available it may be fed to calves as soon as they will eat it, which is usually at three months or more. Silage is not an especially desirable feed for calves, but may prove economical and stimulating to the appetite in the absence of more suitable roughages, such as good legume hay. It is not necessary, therefore, to feed silage if the ration already contains satisfactory feeds.

B. Feed silage in limited amounts.—Calves should be given small amounts of silage daily, as it proves too laxative if fed liberally. Feed 2 to 3 pounds daily to calves three to four months of age, and increase these amounts about 1 pound per day for each month of the calf's age.

C. Use only good silage.—Use every precaution to insure the quality of the silage fed the calves. Moldy or damaged silage may lead to indigestion or poisoning.

13. FEEDING AFTER DISCONTINUING MILK

The period during which calves are most often neglected is soon after milk feeding is discontinued. This is especially true if the calves are turned out to pasture and not given any regular daily feeding or attention to bring them under the observation of the caretaker.

Procedure:

- A. Watch condition of calves carefully.
- B. Feed liberally.

A. Watch condition of calves carefully.—Examine the calves several times a week, noting their general thriftiness. It is not necessary that they remain fat, but they should keep growing, the hair should be sleek and the hides soft, and there should be no evidences of indigestion. As calves that are growing rapidly often present a gaunt appearance, it is sometimes difficult to tell whether they are gaining in weight or not. A simple method of checking this accurately is by weighing the calves weekly or by measuring the height at the withers.

B. Feed liberally.—Feed the calves liberally from the time milk feeding is discontinued. Good legume hay and concentrates are among the best feeds, although good pasture is also desirable. (See discussion of concentrate mixtures under General Information at end of chapter.)

14. PASTURING CALVES

Calves should be turned into a separate pasture, watched carefully, and supplied with everything that they require.

Procedure:

- A. Use separate pasture for calves.
- B. Pasture calves only when six months or more of age.
- C. Watch condition of calves at pasture.
- D. Supply water, shade, and minerals.

A. Use separate pasture for calves.—Provide a small paddock or separate pasture for calves, if possible. This is especially desirable in order to prevent injury by the older animals, to avoid nursing of cows in milk, and to prevent the calves from exciting the cows by running about among them.

B. Pasture calves only when six months or more of age.—Do not attempt to have calves less than six months of age secure

much of their feed from pasture. The annoyance of flies, exposure to the heat of the sun, and excessive exercise are disadvantages of pasture which more than offset the value of the small amount of feed gathered.

C. Watch condition of calves at pasture.—Make sure that the calves are receiving sufficient feed to keep them growing



FIG. 75.—PREVENTING THE GROWTH OF HORNS ON A YOUNG CALF

Treating the horns of young calves with caustic potash, as shown in the illustration, is very effective in preventing the growth of the horns and causes less harm to the animal than removing the horns after they become full-grown.

rapidly. If the pasture alone is not adequate for this purpose, feed some supplements, as indicated above under Section 13.

B. Supply water, minerals, and shade.—Give the calves access to a constant supply of fresh water and common salt. If the pasture consists of non-legume grass growing on an acid soil, it is well to give the calves some mineral supplement,

such as rock phosphate, steamed bone meal, ground limestone or wood ashes. Provide shade in very hot weather.

15. PREVENTING GROWTH OF HORNS

The practice of dehorning cows in order to prevent them from injuring one another is considered very humane. A fight between horned cows frequently results in severe injury and sometimes in death. It is much easier, and causes less suffering, to prevent the growth of the horns than to remove them after they are full-grown. Dehorning is not ordinarily practiced in show herds, since well-shaped and polished horns are considered an additional point of merit in the show ring.

Procedure:

- A. Watch for growth of horns on calves
- B. Clip hair around horns.
- C. Apply vaseline to skin around horns.
- D. Apply caustic.

Equipment:

Scissors, vaseline or salve, caustic.

A. Watch for growth of horns on calves.—The horns begin to form little prominences, or buttons, on the head when the calf is but a few days old. When these can be plainly felt, which occurs when the calf is about a week old, they should be treated to prevent further growth of the horns.

B. Clip hair around horns.—Clip the hair closely around each of the horns, exposing a clean surface of the skin. Use sharp scissors for this purpose.

C. Apply vaseline to skin around horns.—Apply some vaseline or other salve to the skin around the horn, but do not apply it to the skin covering the tip of the horn. The purpose of the vaseline is to prevent the caustic from spreading and injuring the skin.

D. Apply caustic.—For this purpose use a stick of caustic (caustic soda or caustic potash, which can be secured at a drug store). Keep all except the tip of the stick carefully wrapped in paper to protect the hands. Have someone help hold the calf still. Moisten the tip of the stick of caustic slightly in water and rub firmly on the skin covering the tip of the horn. Rub until the skin becomes red and is about to bleed. Be careful not to get so much water on the caustic that it runs down on other parts of the skin or into the eyes of the calf.

If the treatment is effective, a deep scab will form in two or three days. This will slowly heal, and in the course of a few weeks the scab will drop off and hair will return. If the first treatment is not effective, repeat after the fourth or fifth day, rubbing a little more vigorously.

16. MARKING CALVES FOR IDENTIFICATION

Some reliable system of marking animals for identification should be employed in every herd. The method described in this section has been found satisfactory for calves.

Procedure:

A. Mark calves as soon as possible.

B. Adopt permanent system of marking.

A. Mark calves as soon as possible.—Before the calf is separated from its mother, that is, within a day or two after birth, place a strap bearing a numbered brass tag about the calf's neck. Enter the number, together with date of birth, weight, etc., in your record book. If the calf is other than a solid color, sketch the outlines of the color markings in the place provided in your herd book, and enter there, also, the appropriate data. The sketching should be done within a week or two after birth.

B. Adopt permanent system of marking.—The neck straps with numbered tags are satisfactory until the calf is a year old, but there is always danger that the strap may become broken

and lost. A more permanent system of marking, such as one of those described in Chapter XIV, should be adopted, and all calves should be marked according to that system before they are more than one year of age.

GENERAL INFORMATION

Essentials of a good ration for calves.—The young calf needs a ration which not only furnishes all of the nutrients necessary for maintenance and growth, but which is strikingly different from rations of mature animals in that it must be very easily digested. Milk contains chiefly proteins, sugar, butterfat, minerals, vitamins, and water, all of which are very readily digested and utilized by the young calf. Milk proteins are distinguished from most proteins of vegetable feeds in having all of the amino acids, or building stones, which are needed for growth. Milk is, in fact, the only feed so far known that will satisfactorily nourish the calf from birth until it is several weeks old.

The digestive tract of the calf but a few days old can not digest rough feeds such as hay, oat hulls, corn stover, etc., which are high in fiber content. Investigations show that calves can digest very little pure starch until they are a week or more of age; their ability to digest starch increases up to the time they are four weeks old. It is, very important, therefore, that calves be fed milk in the amounts required until they are able to utilize feeds containing starch and fiber. Even after that time, milk should be fed to supply those essentials, such as a complete assortment of amino acids, vitamins, and minerals, in which the other part of the ration may be deficient.

Extensive calf feeding trials at the University of Illinois have shown that calves must have milk until they are at least sixty days of age. Even then, some calves were greatly benefited by feeding milk for a longer period. In no case was it found possible to discontinue milk at sixty days of age unless the calf had become accustomed to eating liberal amounts of

hay and grain. These trials, which were for the purpose of determining the minimum amounts of milk required for rearing calves successfully, showed that calves that were fed a total of about 400 pounds of whole milk up to the time they were two and one-half months old, and at the same time were self-fed on



FIG. 76.—EXPERIMENTAL FEEDING STALL FOR A CALF

At the University of Illinois, calves were placed in individual box stalls where they had access to several different kinds of concentrates and hay. This is known as the "self-feeder method." It is not recommended for use after the calves are three to four months of age.

concentrates and legume hay, made excellent growth. Smaller amounts of milk were insufficient.

Further trials at the Illinois Station indicated that commercial calf meals, as then commonly manufactured, could not be used successfully as complete substitutes for milk any earlier than could good concentrate mixtures fed with legume

hay. Much better growth can be secured if commercial calf meals are used merely as supplements to milk rather than as substitutes for it. These meals have the advantage, however, of being easily made into the form of a gruel and are usually somewhat better suited for young calves than ordinary concentrate mixtures, although the relative costs must be considered.

TABLE XVI

AMOUNT OF FEED CONSUMED BY DAIRY HEIFERS FROM BIRTH TO ONE YEAR OF AGE

(Results Expressed in Pounds per Head)

Feed	Lot I * 20 Holstein Heifers	Lot II † 29 Holstein Heifers	Lot IV ‡ 40 Jersey Heifers	Lot IV ‡ 20 Jersey Heifers
Whole milk.....	244	499	465	342
Skim milk.....	860	2786	2928	3165
Concentrates.....	1107	658	597	547
Hay.....	1067	768	709	857
Silage.....	1669	586	468	353
Corn stover.....	.....	28	40	.....
Pasture (days).....	.....	128	122	123

Live Weight and Gain in Weight

Weight at birth.....	92	82	56
Weight at 1 year.....	532	564	472
Average daily gain.....	1.2	1.3	1.1

* Ill. Agr. Exp. Sta., Cir. 202 (Heifers given no pasture).

† Ohio Agr. Exp. Sta., Bul. 289.

‡ U. S. Dept. Agr. Bul. 49.

A. Value of colostrum.—The first milk secreted by the cow after calving, called colostrum, is very beneficial to the calf in helping its digestive tract to function properly and also in transferring to the calf certain minute bodies which help protect it against infectious diseases. It has been found that most calves that do not receive the colostrum die within a short time. The

feeding of the whites of eggs, mixed raw with the milk, has been observed to afford some protection against disease, similar to the protection afforded by colostrum. The egg whites are given at the rate of six in the milk of the first feeding and are gradually reduced to one or two in a feeding by the end of a week.

B. Amount of Milk to be fed.—A good rule to be followed in determining the amount of milk to be fed is that 1 pound of milk should be fed daily for each 10 pounds of live weight of the calf, with a maximum amount of 15 to 18 pounds daily. During the first seven days of feeding, this amount of milk should be divided into three or four feeds.

When scales for weighing the calves are not available, the data in Table III may be used as a guide to the normal weight at various ages.

Table XIII suggests a milk-feeding schedule to be followed when it is desired to raise calves on the minimum amount of milk possible and use concentrates and hay as supplements. Calf meal may be fed in addition to the milk, if desired.

C. Concentrates for calves.—It is a common practice to mix flaxseed meal or blood meal in the milk for calves. Such high-protein feeds may have some value in preventing an over-laxative condition, but they are not the best supplements to milk for the nutrition of the calf. Milk is in itself a high-protein feed, skim milk having a higher proportion of protein than whole milk, so that any feed used with it should be low in protein and high in carbohydrates.

Good concentrates for calves are corn, oats, wheat bran, linseed oil meal, hominy feed, dried beet pulp, and wheat middlings. These may be fed separately; or the corn, oats, wheat bran, and linseed oil meal may be mixed in equal parts by weight. Another good mixture consists of ground corn 10 parts, ground oats 50 parts, wheat bran 30 parts, and linseed oil meal 10 parts by weight. Calves under three months of age generally prefer finely ground feeds, but after three months

the whole grains may be fed. Cottonseed meal often proves poisonous to young calves and should not be fed.

The amount of concentrates consumed by calves under the usual plan of feeding is about 2 pounds per head per day when the calves are two to three months old, and 3 to 4 pounds when they are six months old. When self-fed, however, calves six months old may eat as much as 6 to 8 pounds daily.

D. Bedding for calves.—Clean, dry wheat or oat straw, or shredded corn stover makes excellent bedding material for calves. Shavings and sawdust are not good for bedding young calves, particularly for those which receive milk only, since such calves may eat some of the bedding. Fatal results usually follow the eating of shavings or sawdust.

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COMMUNITY STUDIES

Visit some of the dairy farms where calves are being raised and obtain information on the following points. If possible, make one visit during the winter and another visit to the same farm during the pasture season.

1. At what season of the year are most of the calves born?
2. Is any special provision made for receiving calves at birth in clean, dry box stalls?
3. Is the navel of each calf disinfected soon after birth?
4. How long are the calves permitted to remain in the stall with their mothers, or to nurse their mothers?
5. How are the calves taught to drink?
6. Is each calf fed its mother's milk, or is it given mixed milk from the herd?
7. How many times daily are the calves fed whole milk?
8. How much milk is given at each feeding?
9. How is the amount of milk to be fed determined?
10. Is milk weighed or measured at each feeding? How?
11. Is the milk warmed before feeding, and if so, how is it warmed?
12. Is a thermometer used to determine the correct temperature?
13. How is milk kept from freezing in winter and from souring in summer?
14. Are the horns of the young calves treated to stop their growth?
15. If so, how is this done?
16. If skim milk is fed, secure the following information:
 - (a) Is the milk separated at home by means of a hand or power cream separator?
 - (b) Is milk fed fresh from the separator without further warming?
 - (c) If skim milk is purchased, has it been pasteurized or otherwise treated to make it safe for feeding?
 - (d) At what age is skim milk substituted for whole milk?
 - (e) How rapidly is the substitution made?
 - (f) What rule is followed in determining the amount of skim milk to be fed?
 - (g) Are calves stanchioned at feeding time?
 - (h) Is foam removed from milk before feeding?
 - (i) If milk is heated before being fed, how is this done?
 - (j) How old are the calves when skim milk feeding is discontinued?
 - (k) How much do the calves weigh at the end of the skim-milk feeding period?
 - (l) What has been the daily gain in weight of each calf?
17. If a home-mixed calf meal is used, what are the substances used, and how is the meal mixed?

18. If either a home-mixed calf meal or a purchased calf meal is fed, make the following inquiries:
 - (a) How is the meal prepared for feeding?
 - (b) How old are the calves when meal is first fed?
 - (c) How is the amount to be fed determined?
 - (d) What amount of whole milk or skim milk is fed in addition to the calf meal?
 - (e) What is the age of the calves when milk feeding is discontinued?
 - (f) What is the age and weight of the calves when calf-meal feeding is discontinued?
 - (g) What is the rate of gain in weight per day?
 - (h) How does the cost per pound of gain in weight compare with the cost per pound of gain of calves on other farms, which have been fed skim milk?
19. At what age are calves first fed concentrates?
20. What concentrates are fed at first?
21. What concentrate or concentrate mixture is used when the calves are three months old? Six months?
22. At what rate are the concentrates fed?
23. Are the concentrates fed in a pail after feeding milk, or in a trough or manger?
24. Are concentrates fed individually to each calf or to several calves as a group?
25. At what age is roughage first fed?
26. What kinds of roughages are used?
27. Is roughage available at all times?
28. If silage is fed, at what age do the calves begin to eat it?
29. How much silage is fed to one calf daily?
30. How are the calves fed after milk feeding is discontinued?
31. Are the calves pastured before they are one year of age?
32. Is feed in addition to pasture provided?
33. Is shade provided?
34. Are the calves given access to salt or other minerals?
35. How are the calves marked for identification?
36. Are the pails and other utensils used in feeding the calves, the cream separator, etc., frequently washed and scalded?

CHAPTER XII

FEEDING AND DEVELOPING DAIRY HEIFERS

The size and development attained by a dairy heifer before the birth of her first calf is very largely dependent upon the character of the feed and care she has received. Heifers are often neglected after they are old enough to live on feeds other than milk. While dairy cows continue to grow until they are four or five years of age, those that are undersized at their first calving may not reach normal size unless very liberally fed, for the production of milk tends to check the rate of growth. It is good practice, therefore, to feed heifers very liberally and give them the best of care in order that they may be at least normal in size by the time they are ready to produce milk.

1. FEEDING HEIFERS AFTER THE MILK PERIOD

Considerable care and thought should be given to the feeding of growing heifers, in order that all necessary elements, in correct proportions, may be present in their rations.

Procedure:

- A. Note condition of heifers frequently.
- B. Provide good pasture, if possible.
- C. Supply supplements to pasture when necessary.
- D. Furnish water, minerals, and shade.
- E. Give heifers good care during winter months.
- F. Feed liberally in winter.

A. Note condition of heifers frequently.—Close attention must be given the heifers after milk feeding is discontinued, to see that they are consuming enough feed to keep them growing

rapidly. If heifers are changed abruptly from a milk and grain ration to pasture, they usually consume but little feed for a time and lose weight rapidly. It is a good plan, therefore, to see that they are accustomed to eating roughage before they are turned out to pasture. Examine the heifers frequently to see if they are troubled with lice, mange, ringworm, or other ailments. (See Chapter XV for methods of treatment.) Once a month weigh or measure the heifers and determine rate of gain from previous measurements, or compare with normal measurements given in Table III.



FIG. 77.—YEARLING HEIFERS IN A GOOD BLUEGRASS PASTURE

Luxuriant green pastures furnish all the nutrients needed for growth and provide ideal conditions for growing heifers to make their best development.

B. Provide good pasture, if possible.—Good pasture is usually an economical source of feed supply for growing heifers. In addition, it furnishes the necessary growth factors which are often lacking under winter feeding conditions. Provide legume pasture if possible, since legumes furnish protein, which heifers require in large amounts for growth. The legumes also furnish much larger quantities of the minerals necessary for growth than do the non-legumes.

C. Supply supplements to pasture when necessary.—As early spring pasture grass is very high in water content, a pound of fresh grass at that season provides relatively little nourish-

ment. Hence it is best to continue the feeding of a concentrate mixture to young heifers for two or three weeks after they are first turned on spring pasture. During late spring and early summer good pasture alone usually provides plenty of feed for growing heifers; but as soon as the grass becomes dry and the pastures somewhat bare, additional feed must be supplied. Yearling heifers may be fed the same kind of supplements, consisting of concentrates, soiling crops, soilage, etc., that are being used for the cows in milk (Chapter X). Heifers about a year of age or less, however, can not be expected to consume



FIG. 78.—FEEDING JERSEY HEIFERS IN A YARD

Such a rack is very convenient for winter feeding of coarse roughages, such as corn stover, or for feeding supplements to pasture in summer.

enough soiling crops or silage to meet their requirements. For such heifers, provide a concentrate mixture, fed at the rate of $\frac{1}{4}$ to $\frac{1}{2}$ pound daily per 100 pounds live weight, and, in addition, 2 to 4 pounds of legume hay.

D. Furnish water, minerals, and shade.—Supply the heifers with fresh, clean, well water. Water in stagnant ponds may contain disease germs. Permit the heifers to secure all the common salt they desire; and if the pasture and other roughage consist chiefly of non-legumes, give them access to mineral supplements, such as steamed bone meal, rock phosphate, wood

ashes, or ground limestone. Provide shade for the heifers in very hot weather.

E. Give heifers good care during winter months.—It is a decided mistake to attempt to make growing dairy heifers “rough it” through the winter. Do not expect them to secure their principal feeds during the winter months from stalk fields or straw stacks. Protect the heifers from severe weather by housing them in a comfortable, well-ventilated barn. Good housing means a decided saving in the amount of feed necessary for maintenance.

F. Feed liberally in winter.—When the supply permits, feed the heifers largely on legume hay, with some concentrates in addition. Often the coarser portions of clover or alfalfa hay, which are refused by the cows, may be fed to advantage to the heifers. Corn stover and non-legume hay may be used in liberal amounts for heifers, but should be supplemented, if possible, by one feed daily of legume hay. Provide all the roughage the heifers will consume, in order to develop their digestive capacity.

Feed silage, if available, to the extent of about 2 pounds daily per 100 pounds live weight. No harm will result, however, from feeding as much as the heifers will eat, if it is of good quality.

Feed concentrates in addition to the roughage, in order to keep the heifers growing rapidly. Provide concentrates in accordance with the following suggestions:

(1) When legume hay is being consumed at the rate of 1 pound daily and corn silage at the rate of 2 pounds daily per 100 pounds live weight, or in larger amounts, feed $\frac{1}{2}$ pound of concentrates daily per 100 pounds live weight to heifers weighing 500 pounds or less (about one year of age or less). Under the same conditions, feed $\frac{1}{3}$ pound concentrates daily per 100 pounds live weight to heifers weighing over 500 pounds (over one year of age). The concentrate mixture may consist of one-fourth to one-third protein concentrates and the balance ground grains, such as corn, oats, or barley.

(2) When non-legume roughages only (such as timothy, redtop or prairie hay, corn stover, corn silage, etc.) are being fed liberally or in amounts similar to those mentioned above, feed concentrates in the same amounts as given above; but in this case the concentrate mixture must contain from two-thirds



FIG. 79.—BARN FOR YOUNG STOCK, WITH INEXPENSIVE EQUIPMENT
The swinging gates may readily be used to form box stalls.

to three-fourths protein concentrates. If less roughage than the quantities mentioned under paragraph (1) is being consumed, increase the supply of concentrates. Do not use cottonseed meal as a supplement to non-legume roughage, on account of its undesirable effects.

GENERAL INFORMATION

1. FACTORS AFFECTING GROWTH AND DEVELOPMENT OF DAIRY HEIFERS

Various factors have an influence upon the size attained by the dairy cow at maturity. While heredity plays an important part, most of these factors can be controlled by feeding and management.

A. Breed of dairy heifers.—The limits of the size of the calf at birth and the size of the mature individual are determined largely by characteristics inherited from the parents, and these are peculiar to the breed to which the animal belongs. Thus, the average Holstein female is larger at birth than the average Jersey female and, as a rule, attains a larger size at maturity. No known plan of feeding will cause the Jersey calf to develop into as large an animal as the Holstein.

The Jersey heifer reaches her full size of skeleton at about four years of age, while the Holstein continues to grow until she is nearly five years old. The Jersey female attains her maximum weight at about six years of age, while the Holstein reaches this stage when six or seven years old.

B. Size of calf at birth.—There seems to be little, if any, direct relation between the size at birth of calves of the same breed, and their size at maturity, provided they are given a good opportunity to develop.

C. Effect of pregnancy on growth.—Careful records of the rate of growth of heifers during the time they are carrying calves indicate that pregnancy has no material effect upon their rate of growth. Some feed in addition to that required for growth, however, must be supplied for the development and maintenance of the fetus.

D. Effect of lactation on growth.—After a good dairy cow gives birth to a calf, she possesses a strong stimulus to produce milk. The nutrients received in her feed are directed toward the production of milk so far as possible, and often if they are not sufficient, she draws upon her own body tissues. Naturally,

under such conditions, growth is seriously retarded. It is only when young cows are liberally fed that they can continue to grow normally after they have begun to produce milk.

E. Effect of feed supply.—It has been pointed out that the possibilities for growth in an animal are largely determined by the size of the breed. Whether an animal reaches the maximum size for the breed, however, depends mainly upon the character and amount of the feed supply.

Protein in liberal amounts is essential in the ration, since the lean flesh of the animal consists chiefly of protein and water. The feed must furnish material to restore the wear and tear of these tissues, as well as to construct new tissue. The carbohydrates (consisting of starches, sugars, fiber, etc.) and the fats furnish energy for the maintenance of the body from day to day, and also furnish materials entering into the building of new tissues.

Minerals and vitamins are of especial significance in growth. Lime and phosphorus are needed in large amounts. Phosphorus is found in nearly all cereal grains and their mill by-products, and is present in particularly large amounts in cottonseed meal and legume seeds. Lime, however, is found in large amounts in but a few of the feeds used for growing heifers. These feeds are the legume hays and skim milk, and these are by far the best sources of lime now known. In the absence of legume hay in the ration, mineral supplements should be supplied, as discussed in connection with pasture, although even then growth is usually not so rapid as when legumes are fed.

Vitamins promote growth and protect against disease. Present information indicates that growth can not take place in their absence. Vitamins also aid in the assimilation of lime. Fresh, green, growing feeds, legume hays, and fresh milk are the best-known sources of vitamins for growing cattle. Sunlight apparently has a power similar to that of vitamins in aiding the animal to utilize lime. For this reason it is poor dairy practice to keep growing heifers in dark quarters continuously throughout the winter months.

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COMMUNITY STUDIES

When making visits to some of the better dairy herds of the community to observe methods of calf raising, learn the methods used in feeding and developing the dairy heifers.

1. What are heifers fed after milk feeding is discontinued?
2. Are the heifers given close attention and good care?
3. Are the heifers of about normal size for their age?
4. Are heifers weighed or measured in order to determine whether they are making normal growth?
5. With reference to summer feeding—
 - (a) What kinds of pasture crops are used?
 - (b) Does the pasture furnish a large amount of feed?

- (c) Are supplements to pasture offered, and if so, what kinds and in what amounts?
- (d) How are salt, or other minerals, and shade provided?
- (e) How do the heifers secure drinking water while at pasture?
- 6. With reference to winter feeding:
 - (a) How are the heifers housed during the winter months?
 - (b) Are the heifers liberally fed in winter, or do they "rough it"?
 - (c) Are the heifers lean and gaunt, do they carry a medium amount of flesh, or are they fat and blocky?
 - (d) Do the heifers appear to be thrifty and to be growing rapidly?
 - (e) What kinds of roughages are fed?
 - (f) Where and how often are the roughages fed?
 - (g) Is an effort made to cause the heifers to eat as much roughage as possible?
 - (h) Are the heifers fed concentrates?
 - (i) What are the kinds and amounts of concentrates fed?

CHAPTER XIII

FEEDING AND MANAGING THE DAIRY BULL

The feeding and care of the dairy bull are usually given much less attention than they deserve. In but few herds is the feeding of the bull given as much thought as the feeding of one of the best cows; yet very much of the success of the herd depends upon the treatment of the herd bull. Since bulls of the dairy breeds are expected to grow to be about 50 per cent heavier than the mature cows, they must receive plenty of feed of the proper kind. The loss of the breeding powers of bulls is doubtless more often due to a lack of proper care than to old age.

Operations:

1. Feeding the bull calf.
2. Caring for the young bull.
3. Ringing the bull.
4. Dehorning the bull.
5. Leading the bull.
6. Controlling the use of the bull.
7. Feeding the mature bull.
8. Housing and exercising the bull.
9. Caring for vicious bulls.
10. Retaining a good bull.

1. FEEDING THE BULL CALF

It is common practice, in dairy herds containing grade cows, to dispose of the male calves for veal when three to ten weeks of

age. In herds in which the calves are purebred, however, the male calves, as well as the females, are raised. The directions here given for the raising of the bull calf are intended to apply particularly to the calf of good breeding being raised to head a dairy herd.

Procedure :

A. Feed bull calf in same manner as heifer calves.

B. Feed bull calf very liberally.

A. Feed bull calf in same manner as heifer calves.—The bull calf should be fed in much the same way as the heifer calves until he is six months of age. Follow the directions for feeding outlined in Chapter XI; but, if at all possible, continue the feeding of skim milk until the bull calf is at least six months, or better, ten to twelve months, of age. If it is not possible to feed skim milk, extend the period of whole-milk feeding longer than is usually done with the heifers, and supply choice legume hay. If the bull calf shows a greater capacity for feed and growth than the heifer calves, increase the allowance of milk and concentrates somewhat over the amounts suggested, but feed less roughage in proportion to the other feeds than is done with the heifers.

B. Feed bull calf very liberally.—Feed the bull calf so that he will continue to grow very rapidly, particularly after he is six months old. The milk allowance may be as much as 20 pounds daily. There is usually no advantage in feeding more than this. Use especial care in seeing that the bull calf gets plenty of feed when on pasture. When the pasture grass is very watery in the spring and when it becomes dry or scanty in late summer and fall, feed some of the concentrate mixture used for the milking herd. This may be fed in amounts of $\frac{1}{2}$ to $\frac{2}{3}$ pound daily per 100 pounds live weight. Continue to use concentrates as a supplement to pasture for the bull calf, rather than soiling crops or silage. The object should be to promote rapid growth and large size of frame in the bull calf, without enlarging the middle of the animal to such an extent as in the case of heifers.

Provide choice legume hay as the chief roughage, since skim milk and legume hay are the two feeds par excellence for supplying minerals for growth.

2. CARING FOR THE YOUNG BULL

In addition to liberal feeding, the bull calf requires exercise, proper housing, and special care.



FIG. 80.—EXERCISING YARDS FOR BULLS

Bulls must have plenty of exercise if they are to remain in good breeding condition. The open shed provides shade and shelter in summer.

Procedure:

- A. Separate the young bull from the heifer calves.
- B. Provide exercise and good quarters.

A. Separate the young bull from the heifer calves.—When the bull calf reaches the age of five to six months, he should not have opportunity to mingle with heifers or cows that are not pregnant. Should all the cows or heifers in the herd be in calf, however, the bull calf under one year of age may be permitted to run in the pasture with the herd.

B. Provide exercise and good quarters.—Keep the bull calf in good condition by plenty of exercise and good shelter. During the winter, provide a roomy, warm box stall, opening into a yard where the bull may be turned on pleasant days. The stall should be kept dry and clean and should have an abundance of light. In summer, the young bull may be kept in a separate lot or pastured with other bulls or with a herd of pregnant cows. Some shade during extremely hot weather is desirable.

3. RINGING THE BULL

As a matter of safety, a ring, by which the bull may be led, should be inserted in his nose. The ring should be placed in the nose when the bull is from nine to twelve months of age.

Procedure:

- A. Provide ring of non-rusting material.
- B. Tie bull securely.
- C. Make opening in nose by means of trocar.
- D. Pass ring through opening and fasten with screw.

Equipment:

Bull ring, trocar and cannula, file or sandpaper, halter.

A. Provide ring of non-rusting material.—Select a ring of non-rusting material, such as copper, gun metal, or brass. The ring for the young bull should be of light or medium weight. When the bull becomes well grown, this ring should be replaced by one of heavier weight and larger size. It is well to keep an extra ring on hand in case of breakage or loss of the one in use.

B. Tie bull securely.—Before attempting to place the ring in the bull's nose, fasten the bull securely in a strong stanchion, making sure that he can not lunge forward upon the persons inserting the ring. It is best to tie a large animal by means of a strong halter as well as to place him in a stanchion

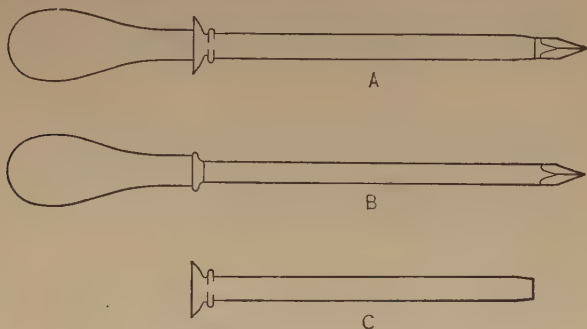


FIG. 81.—TROCAR AND CANNULA

(a) Trocar with cannula in position; (b) trocar alone; (c) cannula. This instrument is used in ringing bulls and in treating severe cases of bloat.

C. Make opening in nose by means of trocar.—The trocar and cannula, illustrated in Fig. 81, is the best instrument for making the opening through the cartilage that forms the dividing wall between the nostrils. The trocar, cannula, and ring should be boiled just before they are to be used, or placed in a disinfectant solution for a few minutes.

Hold the nose firmly with one hand and push the trocar, with cannula in place, through the nasal cartilage at a point a little above the lower end of the nostril, where the cartilage is thin. Withdraw the trocar, leaving the cannula projecting through the nose.

D. Pass ring through opening and fasten with screw.—Insert the open end of the ring in the small end of the cannula and remove the cannula from the nose, at the same time drawing the ring through the nose. Close the ring and fasten it securely by means of the screw. If the ring or the head of the screw

has become roughened it should be smoothed with a file or sandpaper.

If this operation is performed in a barn that does not have a smooth, clean floor, a canvas or blanket should be spread below the bull's head to prevent loss of the screw, in case it should be dropped.

4. DEHORNING THE BULL

Unless the bull is particularly valuable as a show animal, he should be dehorned. He can then be handled with much less danger, and there is less likelihood of his breaking through his enclosure.

Procedure:

- A. Prevent growth of horns when calf is young, or remove horns when he is one to two years old.
- B. Perform operation in fall or winter.
- C. Tie bull securely.
- D. Disinfect instruments.
- E. Remove horns close to head.
- F. Keep wounds clean.

Equipment:

Scissors, stick of caustic, strong stall, halter, dehorning shears or saw, absorbent cotton, adhesive tape, pine tar.

A. Prevent growth of horns when calf is young, or remove horns when he is one to two years old.—If possible, prevent the growth of the horns of the bull calf as soon as the buttons can be plainly felt, which is when the calf is one to two weeks old. This should be done by applying a caustic, as described in Chapter XI. If the growth of the horns was not prevented when the bull was a calf, the horns are best removed when the bull is about two years old. They may be removed when he is a year old, but if the operation is done before this time the stubs may continue to grow.

B. Perform operation in fall or winter.—Plan this work for the cold weather, when there are no flies. It should be done as long before warm weather as possible.

C. Tie bull securely.—The bull must be tied very securely, as dehorning is a painful operation, often causing the bull to break his stanchion or stall in his excitement. An ordinary cow stanchion is usually not strong enough for a bull more than a year old. Confine the animal in a specially heavy stall or



FIG. 82.—METHOD OF EXERCISING BULLS AT IOWA STATE COLLEGE

A strong cable is stretched between tall posts or trees, and the bull tied to a ring which slides on the cable.

cattle chute, or construct a stanchion of 4 by 4-inch pieces. Make the stanchion strong enough to prevent the bull from lunging forward upon the operators or breaking the stanchion by pulling backward. Place a strong halter on the bull and draw his head sharply to one side.

D. Disinfect instruments.—Dehorning shears are generally used for animals not over two years of age. For old animals

with large horns, the dehorning saw is considered best. Place the instrument to be used in a strong disinfectant solution for a few minutes before work is begun.

E. Remove horns close to head.—Cut the horns at a point close to the head, about $\frac{1}{4}$ inch below the line where the skin joins the base of the horn. If possible, watch some one do this work before undertaking it for the first time.

F. Keep wounds clean.—Bleeding always occurs, but usually stops after a short time. Should the bleeding continue, or be severe, cover the wound with a layer of absorbent cotton fastened in place by means of strips of adhesive tape or of cotton cloth. In warm weather put some pine tar on the cotton to keep away flies. Under no circumstances use dirty materials, such as cobwebs, chaff, etc., to stop the bleeding. Keep the animal away from straw stacks or other places where dirt might get into the wounds.

5. LEADING THE BULL

Every precaution should be taken to prevent the bull from injuring persons or animals, or doing any other damage, while he is being led about.

Procedure:

- A. At an early age, train bull to be led.
- B. Always use staff for mature bull.
- C. Use two men when leading vicious bulls.
- D. Treat every bull with caution and respect.

A. At an early age, train bull to be led.—Begin teaching the bull to be led while he is still young. When six to eight months of age, he may readily become accustomed to the halter. Lead him about the barnyard, making him familiar with different conditions, such as the noise of machinery, the sight of other animals, etc. If he is to be exhibited at fairs, train him to pose, as described in Chapter XVII.

B. Always use staff for mature bull.—Do not attempt to lead a well-grown bull without a staff attached securely to a ring in his nose. The bull must be trained to the staff as well as to the halter. In leading the bull with the staff, always walk at his side and never in front of him. Keep his head held high, as a bull can do little damage with his head in that position. Watch him constantly while leading or holding him.

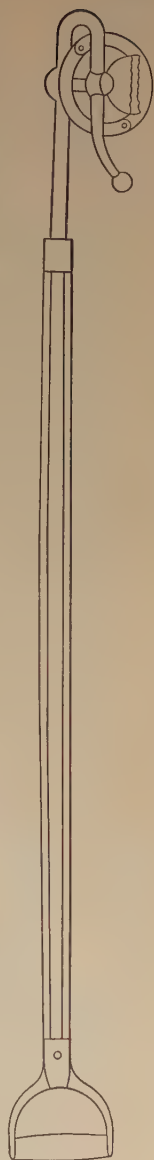
Some staffs are equipped with prongs or teeth which, by a turning of the staff, can be pressed on the bull's nose. This device should not be used except when very necessary.

C. Use two men when leading vicious bulls.—Whenever a bull that is known to be vicious, or one that behaves in a dangerous manner, is to be led, always employ two men. Each man may use a staff, each staff being attached to a separate ring in the bull's nose. A common method of leading such bulls is for one man to use a strong staff attached to one nose ring, while the other man uses a heavy strap snapped into a second ring. In either case, the men walk on opposite sides of the bull, keeping abreast of him, and forcing him to hold his head high.

When a vicious bull, or one whose disposition is unknown, is kept in a yard or box stall, make the animal secure before entering the stall to attach the staff. This may often be done by enticing the bull to the manger by

FIG. 83.—STAFF FOR LEADING BULL, SHOWING METHOD OF ATTACHING TO NOSE RING

This staff is equipped with a saw-edged device which may be pressed against the bull's nose if he becomes unruly.



means of some grain mixture, and then snapping a rope or strap in his ring. The bull may then be tied or held by an attendant before the keeper enters the stall with the staff.

D. Treat every bull with caution and respect.—Whenever a bull is being led, use caution and have respect for his great strength. Accidents with bulls are not always due to the animals' being vicious, but may result from their becoming frightened. Do not take chances when leading a bull, but use every precaution to safeguard yourself and others.

6. CONTROLLING THE USE OF THE BULL

Too early or too frequent use of the bull must be avoided, in order to obtain the best results.

Procedure:

- A. Permit the bull to become sufficiently mature before using him.
- B. Limit the use of the bull.
- C. Keep the bull separate from females at breeding season.

A. Permit the bull to become sufficiently mature before using him.—Do not allow the bull to be used for service before he is twelve months of age, unless he is much above the average in growth and development.

B. Limit the use of the bull.—Until the bull matures (three years of age), the number of females with which he may be mated during a season may be as many as he is months of age. The services of the young bull should be distributed over as much time as possible; it is preferable that they should not occur oftener than twice a week.

Mature bulls may be mated with larger numbers of females than immature bulls, particularly if the breeding season extends throughout most of the year. Under such conditions, one bull may be sufficient in a herd of fifty to sixty cows.

The too-frequent use of the bull is often responsible for the failure of cows to become pregnant and for an early decline in the vigor of the bull.

C. Keep the bull separate from females at breeding season.

—Do not permit the bull to run with the herd except under the conditions described above in Section 2. Keep him confined in a box stall, yard, or pasture, by himself. Permitting the bull



FIG. 84.—INDIVIDUAL BULL SHELTERS AND EXERCISING YARDS

to run with the herd during the breeding season not only makes it impossible to determine the date upon which cows are due to calve, but also may seriously reduce the vigor of the bull.

7. FEEDING THE MATURE BULL

The bull should be kept in good flesh by liberal feeding of concentrates, with limited amounts of good roughage.

Procedure:

- A. Provide roughage of good quality.
- B. Feed concentrate mixture liberally.

A. Provide roughage of good quality.—Provide pasture for the mature bull, if possible. He should not be expected to secure all his feed from pasture, but he will be much better off

if he has a little fresh green grass. If not possible to provide pasture, take to the bull frequently a small amount of fresh grass or soiling crops.

During the time pasture or green crops are not available, feed some good-quality legume hay in limited amounts. As a paunchy bull is considered undesirable, the amount of hay should not exceed $\frac{3}{4}$ pound daily per 100 pounds live weight. For the same reason, the amount of silage fed should not exceed 1 pound daily per 100 pounds live weight.

B. Feed concentrate mixture liberally.—It is obvious that with the limited amounts of roughage suggested, concentrates must be fed to keep the bull in good flesh. Do not permit the bull to become fat unless he is to be exhibited at fairs, since bulls are much less active when fat.

When legume hay and silage in the amounts suggested above form the roughage, it is necessary to feed about 3 pounds of a good concentrate mixture daily per 1000 pounds live weight in order to maintain the bull in fair condition. A mixture composed of equal parts of ground corn, ground barley, or hominy with ground oats or wheat bran, is suitable for use during the non-breeding season. During the remainder of the year, supply the bull with a sufficient amount of a concentrate mixture containing more protein, such as the mixture being fed the cows in milk. During the period of heavy service, it may be necessary to feed more than 3 pounds daily for each 1000 pounds live weight.

8. HOUSING AND EXERCISING THE BULL

On many farms but little importance is attached to the kind of quarters and the opportunity for exercise given the herd bull. Too often the bull is tied closely in a dark, dirty shed, with no outdoor exercise. Since the herd bull has a much greater influence on the success of the herd than even the best cow, he should be kept in the best of health and condition by means of comfortable quarters and regular exercise.

Procedure:

- A. Provide comfortable stall.
- B. Keep stall well bedded.
- C. Arrange yard or paddock adjoining stall.
- D. See that the bull exercises regularly.

A. Provide comfortable stall.—Provide a large, roomy box stall or separate building for the herd bull. For a Jersey or Guernsey bull, a stall 10 by 10 feet in size may be sufficient. A mature bull of the other dairy breeds needs a stall 10 by 12 feet or larger. Do not keep a herd bull confined constantly in a stanchion or tied in a very narrow stall. It is very desirable to have a stanchion in the stall, however, for confining the bull while the stall is being cleaned or while the staff is being attached, etc. Further, do not keep a bull tied in his stall by means of his nose ring, as this makes his nose so tough that it is difficult to lead him with a staff. If it is necessary to keep the bull tied, provide an extra heavy neck strap made of several thicknesses of leather, with a large iron ring and heavy chain.

For northern climates, it is best to have the bull's box stall in the part of the barn where the milk cows or young stock are kept, so that he may be comfortably warm in winter. In sections where the climate is not severe, a separate barn or open shed may be suitable.

Although barns in which the milking herd is kept should be provided with a good floor, such as concrete, the separate bull barn or open shed for the bull may have only a clay dirt floor, if there is good drainage. To prepare a clay floor, scrape the ground free from straw, sticks, and loose surface dirt, and cover with a 5- or 6-inch layer of fresh clay which is free from stones. While the clay is damp, tamp it solid and allow to dry for a day or two before using. A stall or yard paved with cinders is not desirable, because the cinders cause sores between the hoofs.

B. Keep stall well bedded.—In the summer, use only enough bedding to keep the bull from becoming badly soiled, unless bedding is cheap and plentiful; in this case, of course, it

may be used freely at all times. In winter, it is essential that plenty of bedding be used, so that the bull will not have to lie on cold or damp floors. An ample supply of bedding helps to keep the bull comfortable in cold weather.

When the stall has a dirt floor, bedding can be saved, and at the same time the stall can be kept in first-class condition,

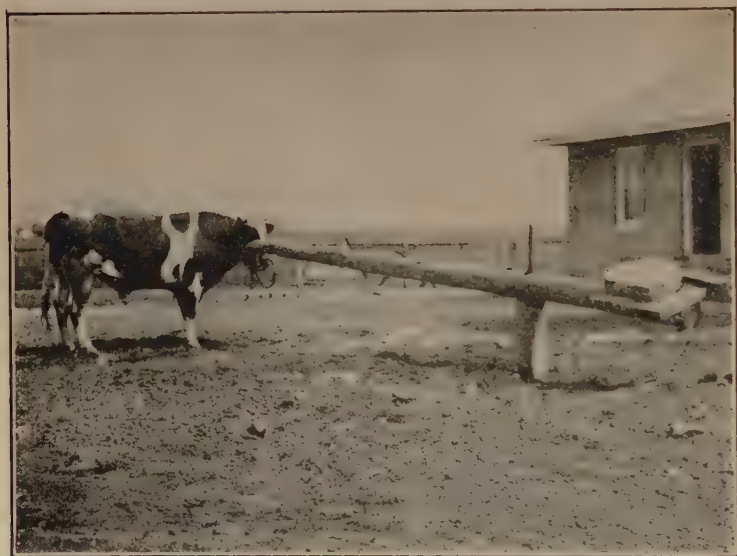


FIG. 85.—A REVOLVING SWEEP AS A MEANS OF EXERCISING A BULL
The bull is tied to the end of the sweep, which he may push about at will.

by using a layer of shavings on the ground with a good covering of straw on top.

C. Arrange yard or paddock adjoining stall.—Arrange an exercising yard or paddock leading out from the bull's stall, so that he can be turned out for exercise daily or whenever the weather is not too stormy. By having the yard in direct connection with the stall, unnecessary leading of the bull is avoided.

The yard need not be paved, but good drainage should be provided. When the bull is permitted to stand in mud puddles

or filth, foot rot or other diseases may occur. Grade the yard, filling depressions and providing sufficient slope so that water drains off quickly. With some types of soil, paved yards are very desirable. Gravel consisting of large smooth stones, brick, or concrete, may be used for paving. Finely crushed rock and cinders are not good for this purpose.

Do not fail to provide a strong wall or fence about the yard.



FIG. 86.—A TREAD POWER USED FOR EXERCISING A BULL

This is an excellent method of providing exercise. The power may also be used for doing light work, such as operating a cream separator or pumping water.

D. See that the bull exercises regularly.—Some bulls take enough exercise when given the freedom of the yard or pasture adjoining their stall. Other bulls under the same conditions will not move about much, and some way must be found to make them exercise. A barrel or stump for the bull to bunt about may be placed in the yard. Some bulls, when young, may be trained to work and used just as an ox is used in drawing loads.

A very satisfactory method of furnishing regular exercise for the bull is to have him operate a treadmill for an hour or more daily. Power may be provided in this way for operating cream separators, milking machines, etc.

When a treadmill is used, the front must be high enough and strong enough to prevent the bull from breaking or jumping out. Often the front of the machine is placed close to a wall. Before leading the bull into the treadmill, be sure that the inclined approach at the rear is firmly secured and that the brake is set. After leading him on to the treadmill, tie him securely so that he can not back out. Remove the approach at the rear, and loosen the brake slightly. If the machine does not start when the brake is off, turn the flywheel a few revolutions. A clutch pulley should be a part of the equipment so that the machinery to be operated can be set in motion after the treadmill has been started. It may be necessary to partly set the brake if the motion is too fast. The bull should not be forced to move faster than when walking at an ordinary gait.

9. CARING FOR VICIOUS BULLS

Many bulls of good breeding are sold for slaughter when but three or four years of age, either because they are difficult to handle or for fear they will soon become vicious and dangerous. While there is great danger in handling bulls that have ugly or vicious dispositions, some of the well-bred animals could be retained longer if suitable arrangements for housing them were available. The following suggestions for providing such arrangements have been tried out successfully.

Procedure:

- A. Provide strong quarters for the bull.
- B. Handle bull as little as possible.
- C. Arrange breeding pen in connection with the bull's quarters.

A. Provide strong quarters for the bull.—The stall in which a vicious bull is kept and the fence surrounding the yard in which he takes his exercise should be made so strong that there will be no danger of his breaking out. When once a bull has broken through a fence, he often tries to repeat the performance. Box stalls in the barn may be employed successfully with a modern bull pen made of heavy steel tubing. Such pens are



FIG. 27.—Good Method of Enclosing Bulls

Bulls are sometimes housed together in the same building with chickens. This method can not be recommended as a general practice on account of the danger of injury.

strong, may be readily cleaned, and permit the caretaker to observe the actions of the bull.

When the bull stall is to be constructed of wood, line it on the inside with 2-inch plank, bolting or nailing the plank to strong posts securely set in the ground or fastened to the framework of the building.

Make the exercising yard equally secure. It may be enclosed by solid walls of stone brick, or concrete. Another plan is to use large cement posts with horizontal openings 16 to

12 inches apart through which iron pipes of $1\frac{1}{4}$ to $1\frac{1}{2}$ inches inside diameters are placed. In making such a fence, thread each piece of pipe and join the pieces firmly by couplings or unions. Use not less than five horizontal bars of pipe, and have the posts not more than 8 feet apart. The total height of the wall or fence must be 5 or 6 feet.

Wooden fences are satisfactory if strongly constructed and kept in repair. In constructing wooden fences, use posts

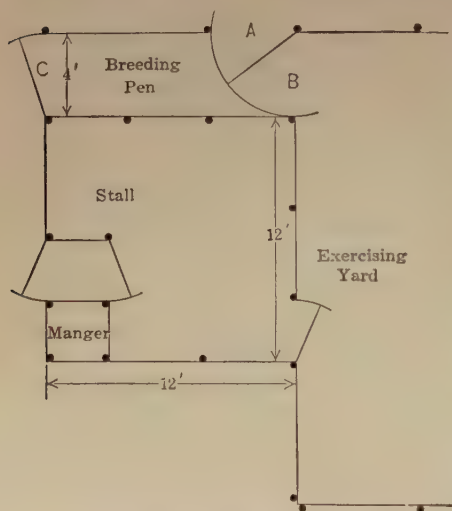


FIG. 88.—FLOOR PLAN OF BULL STALL AND EXERCISING YARD

For a discussion of this plan, see Chapter XIII, Section 9.

9 or 10 feet in length and 6 inches or more in diameter, and set them about 6 feet apart. Nail the poles or plank (2 by 6 or 2 by 8-inch pieces) on the inside of the posts so that the fence is smooth on the side next the bull. Place the poles or plank so close together that there is no chance for the bull to get his head between them, and so near the ground that he can not get his head below them.

If the stall is provided with a wooden manger, place one or more planks above the mangers so that

there will be no possibility of the bull's getting his feet in the manger or climbing out of the stall by way of the manger.

B. Handle bull as little as possible.—Arrange the quarters of a vicious bull so that he may be fed, watered, and cared for with practically no handling. The arrangements shown in Fig. 88 make this possible. To clean and bed the stall, shut the bull into the yard by closing the door, then remove the

manure and take in the bedding through the inside door in the stall.

C. Arrange breeding pen in connection with the bull's quarters.—The need for handling the bull may be greatly lessened by arranging a breeding pen as part of the bull's quarters. Fig. 88 shows such an arrangement.

When a cow is to be bred, close gateways *B* and *C* and bring the cow into the breeding pen through gateway *A*. Then close gateway *A*, thereby opening gateway *B*. In removing the cow, first force the bull into the exercising yard and close gateway *B*. Then lead the cow out through gateway *C*.

A breeding crate, such as that shown in Fig. 89, may be placed in the breeding pen if desired. When such an arrangement is used, the cow must be taken out of the pen through gateway *A* as well as brought in that way.

10. RETAINING A GOOD BULL

It is worth while to devise ways of using a good bull for as many years as possible. In grade herds in which the milking herd is replenished by the purchase of cows, little attention is given the quality of the herd bull, and when his usefulness ceases he is sold for beef. In herds in which calves are raised to maturity, however, much care must be exercised in the selection and use of the bull if good calves are to be secured. Most dairy herds are of such size that not more than one herd bull is kept; and here the problem is to secure another bull whenever the daughters of one become of breeding age, which is about every two years, in order to avoid inbreeding in the herd.

Many bulls are sold before their real worth has been discovered. The first daughters of a bull usually do not complete their first lactations until their sire is about five years of age. Unfortunately, relatively few bulls are kept to that age; and if the daughters are later found to be exceptionally good milkers, it is usually then too late to get the bull back.

There are several ways in which a bull may be kept in ser-

vice until his real value is known. One of the most practicable is by the use of a cooperative bull or herd-improvement association, as discussed in Chapter VI. In the absence of such

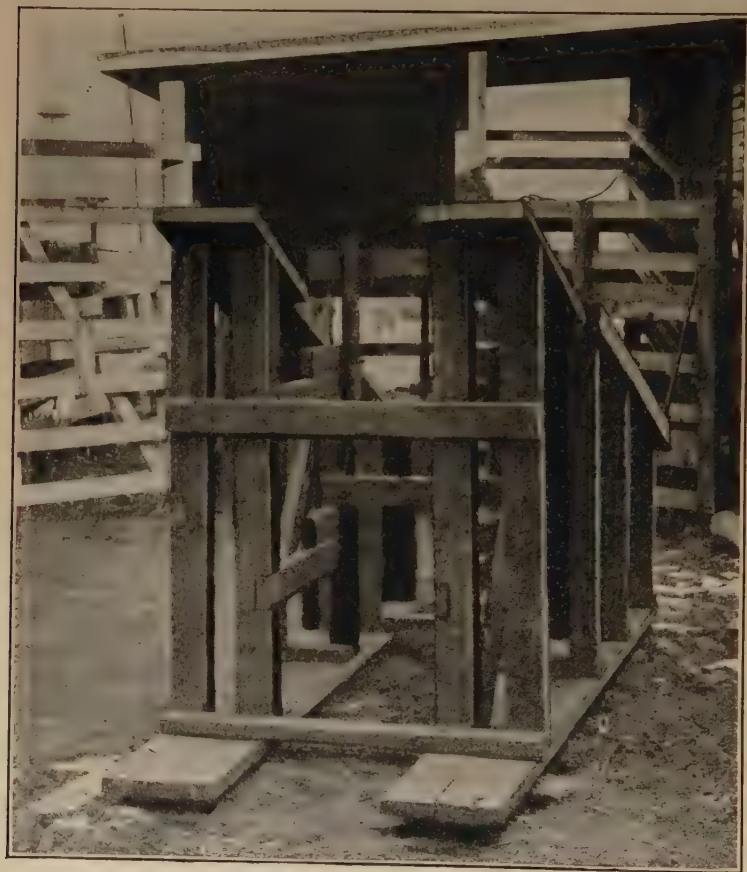


FIG. 89.—A BREEDING CRATE

an association, two or three neighbors may exchange their bulls every two or three years; or, in the case of valuable purebred herds, some of the more promising bull calves may be loaned or

leased to smaller herds for a few years. In large herds where two or more herd bulls are kept, inbreeding may easily be avoided for some time, and bulls may therefore be retained for a much longer time than if there were but one bull at the head of the herd.

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COMMUNITY STUDIES

Visit several of the leading dairy herds of the community and pay especial attention to the care given the herd bulls. Include among the farms visited one or more that have herds of purebred dairy cattle and make a specialty of raising valuable breeding stock.

1. Is the bull calf that is being raised to head the herd given any better care than the heifer calves?
2. How is the bull calf fed and cared for?
3. At what age is the bull calf separated from the heifers?
4. What methods of exercise and what kind of quarters are provided for the young bull?
5. At what age is a ring put in the bull's nose?
6. What kind of a ring is used?
7. Was the bull dehorned when a calf, or if not, at what age?
8. How was the dehorning done?
9. Is the bull led by a rope or staff, or both?
10. If a staff is used, how is the bull caught and the staff attached?
11. At what age is the bull put into service, and to how many cows is he mated during the season?
12. What kind of shelter is provided for the bull?

13. Does the plan of housing the bull keep him comfortable and provide plenty of sunshine and fresh air?
14. What method of exercising the bull is used?
15. If an ugly or vicious bull is kept, how is he housed and used?
16. What is the construction of walls and fences about the bull's shelter and yard?
17. How many years is the bull kept in service?

CHAPTER XIV

MANAGING THE DAIRY HERD

Operations:

1. Numbering stalls.
2. Identifying cows.
3. Marking cattle.
4. Arranging the daily stable program.
5. Determining the time for freshening.
6. Giving the cow a rest.
7. Caring for the cow at freshening.
8. Milking a cow at first calving.
9. Milking cows more than twice daily.
10. Developing persistency in milking.
11. Preventing cows from kicking.
12. Preventing cows from sucking.
13. Keeping the cows comfortable.
14. Providing drinking water.
15. Protecting cows from flies.
16. Grooming cows.
17. Dehorning cows.

1. NUMBERING STALLS

It is essential that each cow in the herd occupy the same stall whenever she is in the stable, and that she be known by a name or number placed in a conspicuous place on the stall. The name or number should be written or printed on both sides of a placard so that it may be read from either the front or the rear of the stall. The caretaker who know his cows can then make certain that each cow enters her own stall when the cows are admitted

to the barn, and also can quickly ascertain the herd numbers of the cows at feeding and milking times so that fewer mistakes will be made in the records

Procedure:

- A. Secure name plates.
- B. Attach name plates to stalls.
- C. Label name plates.



FIG. 90.—FOOD AND SHELTER A LA MODE

Good dairymen do not care for cows in this way. Contrast this picture with Fig. 91.

Equipment:

Name plates, wrench, thin boards, saw, hammer, nails, paint, paint brush, chalk.

- A. **Secure name plates.**—The most satisfactory name plates for modern stalls constructed of steel piping are those manu-

factured for the purpose by the makers of the stalls. The plates are of several different types, but perhaps the most practical is the kind that consists of a cast-iron or pressed steel frame with clips for bolting to the horizontal top rail of the stall. The frame contains a removable cardboard or light wooden board for lettering with crayon.

Homemade name plates may be used and are suitable, espe-



FIG. 91.—HOLSTEINS ON THE BANKS OF THE FOX RIVER IN WISCONSIN

"Milk from contented cows" is a well-known advertising phrase. Some of the prime requisites in securing contentment for dairy cows are an abundance of palatable, nutritious feed and comfortable surroundings.

cially for wooden stalls. Cut pieces of beaver board or thin wooden board about 5 by 12 inches in size.

Thin boards from packing boxes may be used. Paint the boards black and allow to dry.

B. Attach name plates to stalls.—Metal name plates are usually provided with castings or clips for attachment to the

horizontal top rail of the stall. Loosen the bolts and clamp to the rail, tightening the bolts securely.

Wooden name plates should be attached to the horizontal wooden top rail of the stall. Nail the name plate board to the top rail, placing it so that the board extends about 4 inches above the rail.

C. Label name plates.—As short names are preferable for use on the name plates and record sheets, it is common practice to designate purebred cows having several names either by number or nickname. Print the herd number or nickname on both the front and the back of the name plates. Common white crayon may be used satisfactorily on the black painted boards. The crayon may be readily erased and the number changed if the cow is given a different stall.

2. IDENTIFYING COWS

Unless the cows in the herd can be readily identified, it is impossible, of course, to keep production records. The cows must be taught to enter their individual stalls so that each time they are admitted to the stable they will enter them of their own accord; but the caretaker should be able to recognize the animals quickly, so that if at any time any cows should exchange stalls, he will instantly know it. Even though the caretaker may know the cows, it is desirable to have a permanent record of the identity of each animal in case of a change in milkers or of the sale of the cattle.

Procedure:

- A. Secure record blanks.
- B. Sketch color markings.
- C. File records.

Equipment:

Record blanks, pen, pencil, 10- by 12-inch board, thumb tacks.

A. Secure record blanks.—Secure a supply of loose-leaf record blanks for keeping breeding records. These may be had from one of the breed associations listed in this book, or from firms given in the references at the end of this chapter. Home-made forms may be made by laying a sheet of carbon paper over a sheet of plain paper, then laying a picture of a cow on the carbon paper and tracing the outline of the cow by means of a blunt soft pencil. Several forms may be made at one time by the use of several sheets of carbon paper, each one being placed between sheets of plain white paper.

B. Sketch color markings.—Fasten several of the blank forms to a 10- by 12-inch board by means of thumb tacks. Take the board into the stable and sketch from the cows the outlines of the color areas. One person should hold the animal at the halter while the one doing the sketching sits on a chair or box so that his eyes are about on a level with the center of the animal's body. Indicate the color in the larger areas by an appropriate letter, such as B for black, F for faun, etc. The dark areas may be shaded later, by drawing straight lines through them. Be sure to enter the number or name of the animal on the sheet showing its markings.

In the case of a cow of solid color, a description of the animal, including mention of any special features, should be entered on the record blank. Some of the items to be mentioned in such description may be the shape of the horns, whether upturned, curved inward, or downward; color of tongue and switch; solid body color, whether light or dark shade.

Small photographs of individual animals pasted on the record blanks are superior to descriptions or color tracings, as they indicate the individual characteristics of the animals.

C. File records.—Collect the records of the color markings and file them alphabetically according to the names of the cows, or numerically according to herd numbers. The records should be kept in a convenient place so that the breeding records, such as calving dates, etc., can be entered on them.

3. MARKING CATTLE

There must be some means by which every animal in a purebred herd can be readily identified. This is also desirable in many grade herds, for accurate breeding records can not be kept unless the herd number or name of each animal is known or can be quickly found. A good system of marking the cattle gives a buyer much greater confidence in the accuracy of the records. There are several different systems of marking cattle, at least one of which should be used in every purebred herd or large grade herd. The more important of these are outlined below:

(1) **Trace color markings.**—Directions for this procedure and for filing the records are given in Section 2 of this chapter.

(2) **Employ neck straps and numbered tags.**—Secure a supply of numbered brass tags, and straps about 1 inch wide, fitted with buckles. The straps should be 3 or 4 inches longer than necessary to reach around the calves' necks, in order to allow for increase in size of the necks.

Place a strap bearing a numbered tag on each calf at the time it is separated from its mother. Record at once in the herd breeding records the name or herd number of the calf, together with the number of the tag used.

Tags of this sort are easily read, and the system is very convenient to use, but the tags are relatively expensive.

(3) **Fasten tags in ears.**—Purchase some numbered metal tags, together with pliers for fastening them in the ears. The tags may bear the name and address of the owner, if desired.

Fasten one of these tags in the ear of each calf in the herd before it is separated from its mother. Do not close the tag tightly, but leave space for the ear to grow.

(4) **Tattoo ears.**—Tattooing may be done when the calf is about one year old. It is of little value with cattle having dark-colored skin in the ears.

Wash the skin on the inside of the ear with soap and water to remove grease. Make the puncture with the tattoo marker and rub in the tattoo oil thoroughly.

4. ARRANGING THE DAILY STABLE PROGRAM

On farms where men are employed to spend their entire time in caring for the dairy herd, regular hours for performing each operation are naturally adopted. On farms where the men milking and caring for the cows are also employed in general farm work, there is a tendency to give the cows insufficient care and, especially during rush seasons, to neglect them. In these cases it is very important that a regular program be planned and followed out.

Procedure:

- A. Adopt a definite program.
- B. Make periods between milkings as uniform as possible.
- C. Feed regularly.
- D. Allow time for extra duties.

A. Adopt a definite program.—The particular order in which many of the stable operations are performed is immaterial, but it is very important that these operations be carried out at regular hours and that the same order of procedure always be followed. Therefore, adopt a definite program which best fits your conditions and keep to it as closely as possible.

B. Make periods between milkings as uniform as possible.—Leaving milk in the udder for a long time tends not only to reduce the amount of milk produced at that time, but also to decrease the yield. The maximum amount of milk is secured when the cows are milked at regular intervals which will divide the twenty-four hours as evenly as may be practical. Consider this fact in arranging the stable program.

TABLE XVII

DAILY FEEDING AND MANAGEMENT PROGRAM

For Seasons when Cows are not at Pasture

<i>Large Dairy Herd</i>	<i>Farm Herd</i>
(Men Employed Especially for Care of Herd)	(Men Employed in Field Work Also)
4:00 A.M.—Herdsman feeds silage and grain; other men clean cows' udders.	5:00 A.M.—Herdsman feeds cows silage and grain; other men feed horses.
4:30 A.M.—Milk cows.	5:15 A.M.—All men milk cows.
6:00 A.M.—Separate milk; feed calves; feed hay to cows; wash utensils.	6:15 A.M.—Separate milk, feed calves; feed hay to cows; other chores.
7:00 A.M.—Breakfast.	7:00 A.M.—Breakfast.
7:30 A.M.—Turn cows out; * clean stables, bed stalls.	7:30 A.M.—Herdsman turns cows out; cleans stables; other men in field when season permits.
8:00 A.M.—Bring cows in; sweep litter alleys.	8:30 A.M.—Herdsman brings cows in. In winter men groom cows, grind feed, get bedding, etc.
8:30 A.M.—11:00—Grind feed; groom cows; fill silage and grain carts; repair machinery, etc.	1:00 P.M.—Herdsman turns cows out; † men in field when season permits.
11:00—2:00 P.M.—Rest period.	4:00 P.M.—Herdsman cleans stables; feeds silage and grain.
2:00 P.M.—Turn cows out; * clean and bed stables.	4:30 P.M.—Herdsman turns cows in; fills silage and grain carts; brings in hay for two feeds.
2:30 P.M.—Bring cows in; sweep litter alleys; groom cows; clean cows' udders.	5:00 P.M.—Other chores.
3:30 P.M.—Herdsman feeds silage and grain; other men milk cows.	5:30 P.M.—Supper.
5:00 P.M.—Separate milk; feed calves; feed hay to cows; rinse utensils; fill silage and grain carts.	6:00—7:15—All men milk cows; feed calves; feed hay to cows.
6:00 P.M.—Supper.	

* If barn is equipped with automatic water bowls, cows are not turned out except on mild or sunshiny days. On such days they may be out from 11:00 to 2:00.

† In severe weather cows are kept in barn, unless necessary to turn them out for a few minutes to water.

C. Feed regularly.—Cows learn to expect their feed at certain times. Arrange the work so that the feeding will be done at the same hours each day. Feeding is generally done near the milking hour; therefore, the dividing of the milking periods as evenly as practical, as suggested above, is also a benefit in distributing the feeding times uniformly through the day.

D. Allow time for extra duties.—In planning the program, allow a little time which can be spent in looking after some of the details of herd care, such as treatment of inflamed udders, care of cows at freshening, changing record sheets, etc. Looking after the small details is very necessary in successful herd management.

A completed suggestive program for the winter months is shown in Table XVII.

5. DETERMINING THE TIME FOR FRESHENING

When pasture is abundant and cheap and the supply of feed for the winter months scarce or very high priced, it is often desirable that most of the cows freshen during the early spring months. Pasture usually provides feed more cheaply than any other source, so that cows freshening in the spring make the most profitable use of pasture.

The prices received for milk or cream during the different seasons must, of course, be taken into consideration also. Even with higher feed costs during the winter months, the greater prices usually received for dairy products during the winter season may make it profitable to have the cows freshen in the fall. It is generally believed that fall-freshening cows, if well fed and cared for, produce more milk in a year than spring-freshening cows.

Some herds are expected to furnish a uniform amount of milk throughout the year. In such a case it is best to have about half the cows freshen in the spring and the other half in the fall.

The freshening of cows in midsummer or midwinter is not a

good practice on account of the danger of extreme temperatures affecting both milk production and the health of the young calves.

Most dairymen prefer to have the cows freshen annually, except in special cases in which cows are being tested for maximum production records.



FIG. 92.—A PAVED LOT FOR COWS

The use of a paved lot such as this is of especial advantage where high-grade milk is being produced. Cows can be kept out of the mud during rainy weather. The lot can be readily cleaned and the manure saved, whereas in an unpaved lot much of it is lost.

6. GIVING THE COW A REST

Cows that naturally give but small quantities of milk tend to remain dry for three to four months of the year. Cows of exceptional dairy tendency, on the other hand, may continue to give milk from one calving to the next. This is a severe tax upon the vitality of the cow and should seldom, if ever, be permitted. In order that some systematic arrangement may be made to secure as great an annual yield of milk as possible and still have the cows in good condition for the next freshening, follow the suggestions given below.

Procedure:

- A. Determine date of freshening.
- B. Dry off the cow.

A. Determine date of freshening.—Consult the breeding records and determine the dates on which the different cows are expected to calve. Make a list of these dates and also of the dates on which the cows should be turned dry.

In deciding upon the date for drying off a cow, consider her condition of flesh and ability as a milker. Cows having good dairy ability should have from six to eight weeks to rest and put on good flesh before calving. Cows of only mediocre dairy ability do not need more than six weeks' rest, as a rule, although they usually are dry for a longer time. Further, it is not necessary that they be in as high a state of flesh at calving time.

Place the list containing the dates when the cows are expected to calve, and when they should be turned dry, in a conspicuous place, preferably beside the milk-record sheet. In herds in which cows freshen in several different months of the year, it may be best to make out a new list on the first day of each month and post it together with the new milk-record blank.

B. Dry off the cow.—There is little difficulty in drying off cows that are not persistent milkers. If such cows are producing more than 15 pounds of milk daily when the drying-off process begins, it may be best to reduce the feed somewhat; but if the production is less than 15 pounds daily, all that is required is less frequent milking. Milk the cow once a day until the yield falls to 5 or 6 pounds daily, when the cow may be milked only once in two days. Leaving some milk in the udder at each milking greatly hastens the drying-off process. With persistent milkers, it is usually necessary to reduce the feed sharply, besides milking less frequently as directed above. In case the cow has been on good pasture, confine her in the stable or yard and feed some non-legume hay, such as timothy, prairie, or redtop, with little or no concentrates. Liberal feeding should be resumed, of course, as soon as the cow is dry.

Sometimes milk collects in considerable amounts in the udder after the cow is thought to be dry. It may be necessary to remove some of this milk at weekly intervals. Such milk should not be used for food.

7. CARING FOR THE COW AT FRESHENING

If the cow has been fed in accordance with the suggestions made in Section 10 of Chapter IX, she should be in such good physical condition that most of the troubles that frequently follow calving will be avoided.

Procedure:

- A. Provide clean, well-bedded box stall.
- B. Keep cow warm.
- C. Do not milk cow before she calves.
- D. Assist cow in calving only if necessary.
- E. Give cow warm water.
- F. Provide laxative feeds.
- G. Make sure that calf nurses.

A. Provide clean, well-bedded box stall.—Directions for cleaning the stall have been given in Section 1 of Chapter XI. Put a liberal quantity of clean, dry bedding in the stall.

Follow the breeding charts closely and note when a cow is expected to calve. As the actual date of calving may be as much as a week or ten days earlier or later than the expected date, one must watch the cow for signs of approaching calving. As soon as it seems likely that she will calve in two or three days, keep her in a box stall instead of a stanchion, while she is in the barn.

B. Keep cow warm.—Whenever a cow freshens during cold weather, careful attention must be given her. Do not permit cold drafts to blow on her, nor turn her outdoors if the weather is very cold. If the stable is not warm enough to be comfortable, keep a blanket on her for a few days. An abundance of dry bedding also helps to keep her warm.

C. Do not milk cow before she calves.—The udders of good dairy cows usually become large and swollen before calving. It often seems that the cow should be milked in order to relieve the strain on the udder, but this should be done rarely, if ever.

D. Assist cow in calving only if necessary.—Most cows are able to give birth to their calves without assistance, and in such cases they should not be disturbed. Occasionally, however, help must be given. One should not attempt to assist a cow that is having difficulty in calving unless he is experienced or has the help of an experienced person.

E. Give cow warm water.—A cow is usually thirsty after calving and would drink a large amount of cold water if given access to it. In cold weather, however, she should not have it, as it might result in giving her a severe chill. Give her water that has been warmed slightly, and for a few days provide water which is not colder than that coming from a deep well.

F. Provide laxative feeds.—After the cow has calved, provide feeds that will keep her bowels moving freely. See Chapter IX, Section 11, for directions for feeding. If the cow seems to be constipated, give her a dose of Epsom salts, following the directions given in Chapter XV, Section 2.

G. Make sure that calf nurses.—It is necessary that the calf receive some of the first milk, or colostrum. Sometimes a calf is too weak to nurse without assistance. When this is the case, assist the calf in standing and in grasping the teats. If it is too weak to stand even with help, feed it some of its mother's milk from a bottle.

8. MILKING A COW AT FIRST CALVING

Cows calving for the first time are often hard to milk on account of their timidity and fright. This difficulty can largely be overcome by following the suggestions outlined below:

Procedure:

A. Accustom heifer to stall.

B. Handle heifer before she calves.

- C. Use gentle methods in milking and caring for cow.
- D. Develop short teats.

A. Accustom heifer to stall.—If a heifer has not been kept in the stall which she is to occupy after she becomes a member of the milking herd, teach her to enter this stall and to occupy it for two or three weeks previous to calving.



FIG. 93.—HOLSTEIN HEIFER AT CALVING TIME

Heifers should be well developed and in good flesh at calving time. Note enlarged and swollen udder, with lymph deposit on underline in front of udder.

B. Handle heifer before she calves.—Accustom the heifer to the presence and touch of a person by spending a few minutes each day, for two or three weeks before calving, in handling her gently. A good way to begin, if the heifer has never been handled, is by gentle patting or by brushing with a stiff brush. Later, rub and handle the udder gently.

C. Use gentle methods in milking and caring for cow.—Try to develop good habits in the young cow by gentle treatment. Since the udder is very tender at first calving, use care

not to hurt the cow when milking her. Refrain from shouting at the cows or striking them when letting them into or out of their stalls.

D. Develop short teats.—The teats of some cows are so short at the time of first calving that it is very difficult to milk them. It is sometimes possible to cause the teats to become longer by stripping them gently every day or two, three or four months before calving. There is danger, however, that this procedure, if continued too long or practiced too vigorously, may result in the formation of milk in the udder. A common method of milking such a cow is to permit one or more calves to nurse her for three to four weeks after calving. This helps not only to lengthen the teats, but also to remove some of the inflammation from the udder.

9. MILKING COWS MORE THAN TWICE DAILY

Milking more than twice daily does not materially increase the milk flow of low-producing cows, but has a very decided effect upon the yield of high-producing cows. When labor is available, it may be a paying practice to milk high-producing cows three or four times daily.

Procedure:

- A. Select cows to be milked more than twice daily.
- B. Arrange regular hours for milking.
- C. Determine economy of procedure.

A. Select cows to be milked more than twice daily.—A cow of one of the larger breeds, such as the Holstein, which is capable of producing more than 50 pounds of milk daily, may well be milked three times a day. If she is capable of producing more than 75 pounds a day, it may pay to milk her four times a day. If she is a registered animal, it may be desirable to test her for Advanced Registry.

The yield of Jersey or Guernsey cows producing more than

35 pounds of milk daily may usually be increased by milking three times a day. When cows of these breeds produce upwards of 50 pounds daily, milking four times daily is recommended.

B. Arrange regular hours for milking.—If the herd cows are milked regularly at 5 A.M. and 5 P.M., the “three-time” cows may be milked at 5 A.M., 1 P.M., and 9 P.M. If it is impossible to have four different milking periods during the day, the three-time cows may be milked before the other cows in the morning, again at 12 noon or 1 P.M., and then after the other cows at the 5 P.M. period. When milking four times a day, arrange the milking periods at six-hour intervals, having two of the periods the same as for the regular herd cows, such as 5 A.M., 11 A.M., 5 P.M., and 11 P.M.

C. Determine economy of procedure.—Keep a record of the amount of milk being produced daily by each cow before and after milking three or more times daily. Compute the value of the additional milk secured and decide whether or not the extra labor required should be spent in this way or in some other work.

10. DEVELOPING PERSISTENCY IN MILKING

It is commonly believed that the length of any lactation period is partly due to habits formed during the first period of lactation. Whether or not this is true, there are a few precautions which can be taken to prolong the lactation, as outlined below:

Procedure:

- A. Milk cow clean.
- B. Massage udder after milking.
- C. Employ good milkers.
- D. Rarely delay breeding.

A. Milk cow clean.—Remove all of the milk at each milking. If milking machines are used, strip each cow carefully after the machine is removed. Do the stripping rapidly but thoroughly.

B. Massage udder after milking.—As soon as the stripping is finished, massage the udder gently. Press each quarter of the udder between the hands, placing the hands in front of and behind the quarter, rather than at the sides. Use an upward and downward motion while squeezing the quarter gently. The entire operation need not occupy more than half a minute to a minute.

C. Employ good milkers.—Good milkers should be employed if possible, for they secure from 5 to 15 per cent more milk from the cows than poor milkers.

D. Rarely delay breeding.—It is often recommended that the breeding of cows during their first lactation period be delayed in order to fix the habit of prolonged milk secretion. If breeding is delayed for this reason, however, it often causes the cows to freshen at unseasonable times during the year, except in the case of cows that have calved in midsummer. In such cases, breeding had best be delayed so that the cow will freshen in the fall. There is usually no advantage in delaying breeding merely to prolong the first lactation, unless one is attempting to secure maximum production records.

11. PREVENTING COWS FROM KICKING.

In most cases, kicking can be prevented by making sure that the cow is not hurt or frightened.

Procedure:

- A. Accustom heifer to being handled.
- B. If cow kicks, discover and remove cause.
- C. Use hobbles on persistent kickers.

A. Accustom heifer to being handled.—Handle the heifer, before calving, until she becomes accustomed to the touch of a human being and is docile and unafraid. This is the best insurance against her becoming a kicker after calving.

B. If cow kicks, discover and remove cause.—A cow usually kicks because she is hurt or frightened. The udder may be very tender after calving, or the teats may be sore. Unusual noise and the presence of strange persons or dogs are also causes of kicking. Try to find the cause and remove it. For treatment of sore teats, see Chapter XV.

Do not strike or kick the cow, as this makes matters worse.

C. Use hobbles on persistent kickers.—When a cow persists in kicking after all relief measures have been tried, secure a set of hobbles and fasten them on her legs shortly before attempting to milk. Fit the hobbles on the legs just above the hocks and adjust the connecting chain so that the cow can stand but can not kick.

Do not tie a rope about the cow's body, as this may result in injury.

12. PREVENTING COWS FROM SUCKING

Some cows develop the habit of sucking themselves or other cows. This reduces the milk yield, of course, and should be prevented.

Procedure:

A. Put anti-sucking device on cow.—Secure a metal anti-sucking device and fasten it in the cow's nostrils. Such a device is very effective.

Another method is to have the cow wear a halter, the nose strap of which is covered by another strap through which sharp-pointed nails project outward. The former method is generally preferred.

13. KEEPING THE COWS COMFORTABLE

Cows should be protected from extremes of temperature, drafts, etc., and kept as comfortable as possible by the methods outlined below.

Procedure:

- A. Keep temperature of barn moderate.
- B. Prevent drafts from striking the cows.
- C. Use sufficient bedding.
- D. Provide shade in summer.

A. Keep temperature of barn moderate.—The appetites of cows are sharper when the weather is cold than when it is very hot, but neither extreme is desirable. Try to maintain a uniform temperature so far as possible, preferably between 40° and 55° F.



FIG. 94.—FALSE ECONOMY IN FEEDING DAIRY CATTLE

Corn stover at its best is not a high-grade feed, and corn stalks denuded of leaves and leached by rains are of little value except as fertilizer. It is a question whether cattle can secure enough nutriment from a field such as this to offset the effects of exposure.

B. Prevent drafts from striking the cows.—Provide plenty of fresh air by means of a well-designed ventilation system, as discussed in Chapter XVIII, Section 1. When the weather is cold, do not permit direct drafts from doors or windows to strike the cows.

C. Use sufficient bedding.—Bedding is sometimes very scarce and expensive, but is generally a necessity, since inflammation of the cow's udders is very often due to their coming in contact with cold floors. Whenever possible, use enough bedding to cover the stall floor completely.

D. Provide shade in summer.—Cows suffer from extreme heat as well as from extreme cold. Provide shade trees or a covered shed open on all sides, and give the cows access to the shade for several hours during the hottest part of the day in extreme weather. Some herds are kept in darkened barns during the day in the hottest weather and turned out to pasture at night. Such a plan is not practical unless the barn can be kept fairly cool and well ventilated.

14. PROVIDING DRINKING WATER

A supply of pure, clean drinking water is essential to the health of cattle and must be available at all times.

Procedure:

- A. Secure water supply from good source.
- B. Clean water tanks and bowls frequently.
- C. Keep water above freezing temperature in winter.

A. Secure water supply from good source.—Provide the dairy herd with clean, pure water. That coming from wells, clear running streams, or lakes, is usually satisfactory, but one should not expect cattle to drink water from muddy streams or stagnant pools. The water in stagnant ponds is especially undesirable, since it generally contains slimy growths and may contain disease organisms. When the herd is supplied with water from the same source as that used by the family, one can rest assured that the quality of the water given the animals is satisfactory.

B. Clean water tanks and bowls frequently.—Large water tanks soon become filthy, especially in warm weather, if not cleaned frequently. Every three or four weeks, drain out the water, and scrub the sides and bottom thoroughly by means of a stiff broom. Rinse out the tank and let in a supply of fresh water. Three or 4 pounds of lime placed in the tank after cleaning helps keep down the growth which generally occurs.

Clean automatic water bowls as often as necessary to keep them free from hay or other feed that falls into them.

C. Keep water above freezing temperature in winter.—

Cows do not drink as much water when it is ice cold as when it is warmer, and then, too, drinking ice water may chill the cows severely. Warm the water by means of a tank heater, so that its temperature is 40° to 50° F., or provide an underground tank and gravity or pressure system so that the water is always above freezing.

15. PROTECTING COWS FROM FLIES

Lessened milk production during the summer is generally thought to be due to the annoyance of flies. Insufficient feed is probably a more important cause, but flies may be responsible for a part of the loss. Keeping flies off the cows during the milking hour makes milking easier, and keeping them away from the milk lessens the chances of its becoming contaminated with disease germs. Several methods of protecting cattle from flies are given below. One or more of these methods will be found suitable for use on nearly every farm.

Procedure:

- A. Keep barn and lots free from manure and filth.
- B. Spray cows with a fly repellent.
- C. Darken stable.
- D. Place light blankets on cows.
- E. Screen stable and kill flies.

A. Keep barn and lots free from manure and filth.—Flies lay their eggs in manure heaps and accumulations of filth containing moisture. Clean the gutters and pens in the barn frequently. Haul all manure from the barn and lots, rotting straw piles, etc., and spread on the fields at least once a week during the summer. Scrape the surface of the lots in which there is manure, and fill any mud puddles with fresh soil.

In case it is not possible to take the manure to the fields frequently, cover manure heaps with air-slaked lime or soak them with some coal tar disinfectant solution made up at the rate of 1 part of disinfectant to 20 parts of water. Spreading the manure thinly in the field, however, is more satisfactory, since treatment of the manure pile is seldom thorough enough to destroy all developing flies.

E. Spray cows with a fly repellent.—Purchase a ready-to-use fly repellent or prepare one according to one of the following formulas:

No. 1

2 gals. kerosene
1 qt. pine tar
 $\frac{1}{2}$ pt. crude carbolic acid
1 qt. fish oil

No. 2

$1\frac{1}{2}$ lbs. resin
2 cakes laundry soap
 $\frac{1}{2}$ pt fish oil
Water to make 3 gal.

No. 3

1 gal. fish oil
2 oz. oil of pine tar
2 oz. oil of pennyroyal
1 pt. kerosene

No. 4

1 gal. crude carbolic acid
1 gal. oil of tar
1 gal. cottonseed oil

No. 5

1 lb. laundry soap
4 gals. hot water
4 oz. powdered naphthalene
1 gal. crude petroleum

In preparing No. 5, dissolve the soap thoroughly in hot water, and the naphthalene in the petroleum. Then combine the two solutions while stirring vigorously. Mixtures 1, 2, 3, and 4 may be applied by means of a hand sprayer, while No. 5 may be applied once or twice a week with a brush.

Spray the cows lightly before each milking. They may also be sprayed after milking or just before they are turned to pasture. Some fly repellents blister the skin if applied in too large amounts, so care must be used.

Do not spray young calves too heavily, as their skin is tender.

C. Darken stable.—If cattle are kept in the barn for longer than the milking period, tack tarred building paper to the sash so that no light comes through it, but the window can still be opened if desired.

Hang gunny sacks from the upper part of doorway by which the cows enter the barn and a second lot of sacks at the same height 4 or 5 feet outside the doorway. This helps darken the barn and also brushes the flies off the backs of the cows as they enter.

D. Place light blankets on cows.—Light blankets for protecting cows from flies may be purchased on the market. These are effective but they are also expensive, since many of them become torn if worn at pasture by the cows rubbing against fences, trees, etc.

E. Screen stable and kill flies.—The practice of screening windows and doors of the cow stable and driving out or killing the flies that enter is followed in some instances in which high-quality milk is being produced.

When this plan is followed, screen all windows and doors, and darken the windows with building paper. Provide also an arrangement for brushing the flies off the cows as they enter as described under C above.

As soon as the cows leave the barn, close all the windows and doors except one or two, which are left partly open. Many of the flies will find their way out. If desired, most of the flies may be killed by using pyrethrum powder. To use this, close all windows and doors after the cattle are out of the barn and blow some of the pyrethrum powder into the air by means of a powder blower or an electric fan.

Flies may be poisoned by placing about the stable shallow dishes containing milk to which formalin has been added at the rate of 1 teaspoonful of formalin to a quart of milk. Do not permit animals to drink the milk.

16. GROOMING COWS

Use brush and curry comb daily. Give the cows a thorough brushing each day by means of a stiff brush, and remove manure clinging to the thighs or flanks by means of a curry comb. Grooming not only keeps the coat of the cows in a more healthful condition, but also makes possible the production of clean milk.

17. DEHORNING COWS

It is recommended that the horns should not be permitted to grow on dairy cattle unless the animals in all probability will be exhibited in the show ring. Directions for preventing the growth of horns on calves are given in Section 15 of Chapter XI.

The dehorning of heifers or cows is carried out in the same manner as directed for the bull, Section 4, Chapter XIII.

COMMUNITY STUDIES

Visit some of the nearby herds which are cared for in a good manner and in which records of production are kept. Visits should be made during the winter and during the summer. Observe the methods of caring for the herd, and secure information on the following points:

1. Are the stalls numbered and, if so, how?
2. Is any system used for identifying the cows other than the caretaker's knowing them by sight?
3. If some system of identification is used, of what does it consist and how is it kept up to date?
4. Is any system of marking used on the calves or other cattle? If so, how is it used?
5. Is a regular stable program followed, and if so, at what hours are the various operations performed?
6. Do cows freshen in spring or fall?
7. How long a rest (or dry) period is given the cows before freshening?
8. How is the cow cared for at freshening?
 - (a) Is a separate stall provided?
 - (b) Are precautions taken to keep the cow warm?

- (c) Is the cow milked before calving?
- (d) Is the water for the cow warmed?
- (e) Is a bran mash fed?
- 9. Is there any difficulty in milking a cow at first calving, and if so, what remedies are used?
- 10. Is any effort made to prolong the first lactation period as much as possible?
- 11. Are cows milked more than twice daily, and if so, is the practice considered a paying one?
- 12. What precautions are taken to keep the cattle comfortable?
- 13. If fly repellents are used, what kinds are they and how frequently are they applied?
- 14. What precautions are taken to keep the flies out of the stable?
- 15. Are yards cleaned frequently and is manure hauled to the fields frequently?
- 16. Are cows groomed daily in winter?
- 17. Are the flanks and udders of the cows cleaned before milking?
- 18. What means are used to keep the drinking water above the freezing temperature in winter?
- 19. Are the cattle in the herd dehorned?
- 20. At what age are the cattle dehorned and how is the dehorning done?

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CHAPTER XV

TREATING THE AILMENTS OF DAIRY CATTLE

Dairy cattle are subject to a number of serious infectious diseases over which the caretaker can have little control except that of prevention. There are many ailments of minor character, however, which every herdsman should learn to treat. He should also learn to recognize the more serious diseases and be able to give first aid treatment to animals suffering from them.

When the nature of a disease is unknown, the herdsman should not attempt to treat severe cases or to give medicines unless he is fully competent and experienced. It is often best to secure the services of a competent veterinarian, especially if the affected animal is a valuable one.

Follow the suggestions given below for preventing disease and for providing good care for sick animals. For a discussion of the nature, symptoms, and treatment of the more common ailments, see General Information in this chapter.

Operations:

1. Preventing disease.
2. Providing medicines and instruments.
3. Rendering first aid.
4. Giving general care to sick animals.

1. PREVENTING DISEASE

In the care of cattle, as in other enterprises, it is generally recognized that prevention is better than cure. The following

precautions, if carefully observed, will minimize the danger of disease:

Procedure:

- A. Keep barn and lots clean.
- B. Provide good feed and clean water.
- C. Protect animals from extreme weather.
- D. Disinfect barn after disease has occurred.
- E. Use care in disposing of dead animals.
- F. Isolate new animals brought into the herd.

A. Keep barn and lots clean.—Remove manure and litter from the barn regularly. Do not allow filth to accumulate in the barn and to become the breeding place for flies and other insects. Scrape or sweep the walls and ceilings once or twice a year and follow with a heavy coat of whitewash or paint.

Keep all lots about the barns well graded so that water drains off quickly. Scrape the surface of the lots that are not in grass several times a year to remove manure accumulated on the surface, and haul the manure to the fields.

B. Provide good feed and clean water.—Avoid moldy and damaged feed so far as possible. Moldy silage, grain, and hay sometimes may be fed for several weeks without harm, but dangerous illness may be caused at any time. Pasturing cattle on alfalfa or the clovers immediately after frosts very often proves harmful.

Provide clean drinking water and frequently scrub out all drinking tanks and bowls. Avoid stagnant ponds as sources of drinking water.

C. Protect animals from extreme weather.—The udder of the dairy cow is a very delicate organ. The skin covering it is thinner than that on other parts of her body. Turning cows out in a yard where they are exposed to the wind in zero weather may be sufficient to cause inflammation in the udder. The same trouble may occur during extremely cold weather if the udder comes in contact with a bare cement floor or if it is

exposed to a cold draft coming through cracks in the wall or around doors.

Protect cattle from extremely hot sun, also, and be sure that they have sufficient fresh water to drink during hot weather.

D. Disinfect barn after disease has occurred.—When a single animal is attacked by an infectious disease, such as white scours or abortion, remove the animal at once to a separate barn or shed where it will not come in contact with the rest of the herd. Then disinfect the stall or parts of the barn in which the animal has been. When several animals in the herd have been infected, it is often best to disinfect the whole barn after they have been removed.

First clean the barn thoroughly. Remove all manure, feed, and litter, scraping walls, floor, stalls, cupboards, etc., so that the wood or masonry shows a clean surface. Burn or bury the material removed. Soak the clean surfaces and floors with a disinfectant solution. This is best applied by means of a spray pump. Use a disinfectant such as:

(1) A 5 per cent solution of crude carbolic acid. This can be made by mixing 7 ounces of the acid to each gallon of water.

(2) Formalin mixed with water at the rate of 4 ounces to each gallon of water. Care must be used since the fumes given off are irritating to the eyes and nose.

(3) Mercuric chloride or corrosive sublimate mixed with water at the rate of 1 ounce to 8 gallons of water. As this material has a corrosive action on metal, it is best to use old tin pails for it. *Mercuric chloride is a powerful poison* to both man and cattle; therefore, care must be exercised in its use. If any is left over it should be destroyed, or labeled and placed where children or animals do not have access to it. Mangers that have been treated with this solution should be scrubbed out with clean water before feed is placed in them.

(4) Coal tar disinfectants, such as cresol, which forms a milky solution in water, may be used in the proportion of 7 ounces to each gallon of water.

E. Use care in disposing of dead animals.—Too much care cannot be used in the prompt disposal of dead animals and in the disinfection of the stall or ground with which the body has been in contact.

Remove the body of a dead animal promptly to a safe distance from the farm buildings and from all fields to which the cattle have access. Burn the carcass or bury it 5 or 6 feet deep. When animals die at pasture, it is sometimes best not to move the body but to burn or bury it there. If it is to be burned, lay sticks of wood on the ground and by means of poles tip the body over on the wood. Lay a sufficient amount of wood about the body to burn it completely, and burn the poles used in moving the body. If the body is buried, sprinkle fresh lime on the surface of the ground where the animal lay.

The practice of removing the hide from dead animals is not a safe one unless it is known with certainty that the cause of death was not an infectious disease which might be contracted by a person handling the carcass.

Burying animals at a shallow depth in lots or pasture may cause the spread of disease.

F. Isolate new animals brought into the herd.—Put new animals to be added to the herd in a separate barn or shed for a week or ten days, to find out whether or not they are infected and are coming down with some disease. In herds under the care of federal authorities for the eradication of tuberculosis, it is usually necessary to isolate such animals for sixty days or until such time as the animals can be retested for tuberculosis.

2. PROVIDING MEDICINES AND INSTRUMENTS

Every dairy barn should be equipped with some of the more common medicines and instruments for treating simple ailments. Secure a supply of common medicines and instruments such as those suggested below. A special cupboard should be pro-

vided in the barn for storing these supplies. For the principal uses of each of the following, see the discussion of common ailments in the section on General Information below.

Medicines (for herd of 20 cows):

Epsom salts, 10 lbs.

Tincture of iodine, 2 to 4 oz.

Disinfectant, such as crude carbolic acid or other coal-tar preparation, $\frac{1}{2}$ gal.

Castor oil, 8 oz.

Stick of caustic potash or caustic soda.

Instruments:

Trocar and cannula.

Milk-fever outfit.

Drenching bottle (1 qt. bottle with long neck).

Funnel and $2\frac{1}{2}$ ft. of $\frac{1}{4}$ -in. smooth rubber hose.

Clinical thermometer for cattle.

3. RENDERING FIRST AID

In many cases, the animal may be saved, or serious illness avoided, by the prompt application of simple remedies.

Procedure:

A. Observe animal closely to determine cause of illness.

B. If cause of ailment is apparent, give suitable first-aid treatment at once.

A. Observe animal closely to determine cause of illness.—

Keep the animal under constant observation and note all the symptoms in order that you may determine, if possible, the cause of the illness. Often the first sign of illness is the failure of the animal to eat any or all of its feed. The animal may move very sluggishly, or less often may be excited and quick in its movements.

When an animal is in intense pain, it often stands or lies quietly in a drooping position with eyes sunken. Take the temperature of the animal by inserting a clinical thermometer in the rectum and leaving it there for three minutes. If the temperature is much above or below normal (101° to 102° F. in cattle), it is usually best to call a competent veterinarian. If the temperature is about normal and the animal does not seem to be in pain, apply the general treatment outlined below. Note whether there is any improvement or not. If the disease becomes worse, secure competent advice.

B. If cause of ailment is apparent, give suitable first aid treatment at once.—As soon as the cause of illness is discovered, treat the animal at once. Delay may prove fatal.

4. GIVING GENERAL CARE TO SICK ANIMALS

Much can be done by the dairyman to relieve sick animals and give nature a chance to do its part. Following are some of the measures which should be taken:

Procedure:

- A. Reduce feed supply, and provide bulky, laxative feeds.
- B. Keep animal comfortable.
- C. Give laxative, if necessary.

A. Reduce feed supply, and provide bulky, laxative feeds.—As soon as illness is noted, reduce the amount of feed given. Feed no concentrates and only half the usual amount of silage, together with a moderate amount of good-quality legume hay. Some fresh green grass or 15 to 20 pounds of sliced roots is also excellent at such times. Animals that are very sick, of course, will usually eat nothing.

B. Keep animal comfortable.—It is best to blanket a sick animal in cold weather if the barn is cold or drafty. Use plenty of dry bedding to keep the animal off cold floors. Warm the

drinking water slightly. In hot weather, provide shade and keep off the flies by means of a fly repellent or darkening of the stable, or both.

C. Give laxative, if necessary.—If the bowels are not moving freely, give the animal a drench of Epsom salts solution. The dose is about 1 to $1\frac{1}{4}$ pounds for each 1000 pounds live weight. Thus a Jersey cow weighing 700 to 800 pounds requires $\frac{3}{4}$ to 1 pound at a dose, while a Holstein cow requires $1\frac{1}{4}$ to $1\frac{1}{2}$ pounds. Weigh out the salts and dissolve in 2 to 3 pints of hot water. Cool to about body temperature and pour into a long-necked bottle.

To give the drench, have a helper raise the animal's head by a halter. With the left hand, grasp the nostrils of the cow and insert the neck of the bottle into the side of the mouth so that it rests on the middle of the tongue. If the animal coughs, lower the head at once to prevent the liquid getting into the windpipe.

GENERAL INFORMATION

COMMON AILMENTS OF DAIRY CATTLE

The symptoms and treatment of each disease or ailment of dairy cattle differ from those of nearly every other. Some of the chief ailments affecting dairy cattle are briefly described below, together with suggestions for treatment.

If the caretaker is not experienced in treating sick animals, he should by all means secure competent advice whenever there is doubt as to the nature of the illness or the kind of treatment that should be given.

ABORTION

Nature.—The birth of the fetus, or developing calf, before the full term. Abortions usually occur during the fifth, sixth, or seventh month, but may occur at any time during pregnancy.

Causes.—(a) Improper feeding, such as lack of minerals, particularly lime. (b) Severe blows, such as kicking, in the

abdomen. (c) A disease organism, which may be carried from one cow to another and probably is also spread by the herd bull. The organism is the most frequent cause.

Symptoms.—Swelling of the udder and the external genital organs. Birth of calf before time, usually dead.

Treatment.—No certain cure for abortion has yet been found. Treatment consists chiefly in prevention. Action must be taken at once after an abortion occurs, and constant care must be exercised to prevent the disease from spreading through the entire herd. Separate the aborting cow from cows that are not affected. Burn the dead calf, together with soiled bedding, afterbirth, etc. Clean and disinfect the stall where the cow has been.

Keep the cow separate from the healthy animals as long as there is a discharge from the vagina. Flush out the uterus daily with disinfectant solution made by adding $\frac{1}{3}$ ounce of a disinfectant such as lysol, cresol, or carbolic acid to 2 quarts of warm water. Introduce the solution by means of a funnel and soft rubber hose. Do not breed the cow until after all discharges have ceased and until two or three months after abortion.

Some veterinarians and agricultural experiment stations are equipped to make tests for dairymen of samples of the blood of each of the cows in their herds and to determine whether or not each cow is affected with the disease. The test is called the agglutination test.

If a large proportion of the cows in the herd have aborted and the test shows that most of the remainder are affected, it may be best to dispose of the entire herd, disinfect the barn, and secure a new, clean herd. If but a part of the animals are shown to be affected, it is best to isolate them until later tests show that they no longer react. They may then be added to the main herd.

In purchasing valuable animals, it is best to buy them subject to the test for abortion.

BLOAT

Nature.—A greatly enlarged barrel, especially in the region of the upper left flank.

Cause.—The rapid formation of gas in the paunch, or first part of the stomach. This is sometimes caused by indigestion or by the eating of young clover or legumes at the beginning of the season, particularly if the plants are wet from dew or rain. This ailment may follow the eating of fresh beet pulp, frozen roots, pasture grass covered with frost, or spoiled feed of any kind.

Symptoms.—Swelling of the barrel with marked enlargement in the region of the upper left flank. The hide may be stretched so tightly that striking the animal with the fingers at this point gives a sound like that of a drum. The animal appears to be in pain, has difficulty in breathing, and, if not given relief very soon, may die of suffocation.

Treatment.—In mild cases, forcing the animal to walk fast for fifteen minutes may bring relief. A leather halter may be placed on the head and a smooth piece of wood, such as a section of a broomstick 6 to 8 inches long, may be placed in the mouth and attached to the halter as a bit, by means of holes bored through the ends. This causes movements of the tongue and swallowing, permitting some of the gas to escape by way of the mouth.

Medicine may be given as a drench. Two ounces of aromatic spirits of ammonia in a quart of cold water every half hour, or $\frac{1}{2}$ ounce of formalin in 1 quart of water, or 1 to 2 ounces of turpentine in 1 quart of milk or linseed oil are suitable for this purpose.

In severe cases, treatment must be prompt. At a spot on the left side equally distant from the hip bone, last rib, and backbone, make a cut in the skin about $\frac{3}{4}$ inch long and insert a trocar and cannula. Withdraw the trocar and allow the gas to escape through the cannula. The cannula may need to be left in for several hours. After removing the cannula treat

the wound with tincture of iodine. Give a dose of Epsom salts after a severe attack of bloat, and provide a small amount of laxative feeds for a few days.

Giving animals a full feed of hay, silage, and grain, or hay alone, before turning them to pasture the first time in the season, helps to prevent bloat. A supply of straw in a rack should be provided for cows on legume pasture. Cattle should be kept from pastures when frost is on them, and should not be allowed to pasture on legumes for several hours after heavy frost has disappeared from the plants.

COWPOX

Nature.—Small lumps, containing yellow pus, on teats. Bad sores develop if lumps are rubbed off by the hand.

Cause.—An infectious organism, usually carried from cow to cow on the hands of the milker.

Symptoms.—In four to seven days after a cow is infected, the temperature rises, the udder becomes red, little hard lumps appear on the teats and udder, and the milk flow is reduced. The lumps have a blister-like appearance at the top and contain a yellow pus. They disappear in sixteen to twenty days.

Treatment.—Isolate the cow. Milk her the last of the herd. If there are open sores, the milk should not be used, as the disease may be contracted by man. If teats are very sore, use milking tubes to remove the milk.

Bathe the udder twice a day with a solution made by dissolving 1 ounce of granular hyposulphite of soda in 1 quart of warm water. The milker should also use this solution for washing his hands after milking infected cows. Rub on the lumps or sores an ointment such as carbolated vaseline, benzoated oxide of zinc, or 1 part boric acid to 7 parts balsam of Peru.

FOOT ROT

Nature.—Soreness between the claws. In advanced cases, pus forms.

Cause.—At first, soreness due to gravel, cinders, or manure lodging between the claws. Later, infection may set in. Cattle walking through deep mud, or pastured on swampy ground, are subject to it.

Symptoms.—A limping gait; heat and swelling above the hoof; pus and foul odor.

Treatment.—Cleanse the parts thoroughly each day with a disinfectant solution, such as 1 ounce of carbolic acid to 1 pint of water. If sloughing has taken place, fasten a wad of oakum or cotton smeared with pine tar between the claws, by means of strips of cloth.

IMPACTION

Nature.—Too free feeding on dry feed, or, occasionally, the eating of materials such as wood, cloth, or weeds. A hard pack of dry feed lodges in one or more parts of the stomach.

Cause.—This trouble most frequently occurs among cows that are being fed for high production records or among those that have obtained access to grain bins.

Symptoms.—The cow fails to eat and produces much less milk than usual. Enlargement occurs in upper left flank, which feels hard or doughy to the touch. The cow stands with back arched, or lies on the right side. There may be heavy, rapid breathing and some bloating.

Treatment.—Give no feed for twenty-four hours or more. Give a drench of 1 to 2 ounces of aromatic spirits of ammonia in 1 quart of milk or water, and later a drench of Epsom salts in 4 quarts of water to which has been added 2 ounces of ginger. Give lukewarm water to drink. Inject 1 to 2 gallons of warm water into the rectum by means of force pump and smooth rubber hose, to move the bowels.

As a last resort, a skilled veterinarian may remove the contents of the stomach through an opening made in the flank.

As a preventive of impaction in animals being fed heavily, moisten the concentrates before feeding.

LICE

Nature.—Several kinds of lice, usually of a dull white color, attack the skin of the animal, first in the regions of the head, neck, and tailhead, and later on any part of the body. The lice attach their eggs, or nits, to the hair of the cattle, where they may be seen as small white bodies.

Symptoms.—Intense itching of the skin. The affected animal will be seen rubbing on posts, gates, etc. In advanced cases, the hair may fall out.

Treatment.—Bathe the animal with a coal-tar preparation, such as creolin, zenoleum, etc., used at the rate of 1 part to 50 parts of water. Repeat in one week to destroy lice that have hatched in the meantime. In cold weather, provide a warm place for bathing the animal, use warm water, and blanket the animal until dry. Unless these precautions can be taken, it is best not to bathe animals in cold weather but to dust an insect powder lightly on the affected parts.

If the buildings and lots are badly infested, it is useless to treat the animals unless these are treated also. Clean thoroughly, and spray with kerosene or one of the common disinfectant solutions.

LUMPY JAW

Nature.—A disease causing a swelling on the jaw or head.

Cause and symptoms.—A fungus, taken into the mouth on the feed, enters the jaw bone or the tissues near it, producing a hard lump which later may break and discharge pus.

Treatment.—It is best to secure the advice of a veterinarian. If free from the bone, the lump may be removed in the early stages by the knife, the wound being treated with antiseptics.

If the bone is affected, treatment consists in giving potassium iodide solution as a drench, the dose being $\frac{1}{8}$ to $\frac{3}{8}$ ounce daily in a half pint of water. At the end of a week or ten days, when the eyes and nose discharge mucus and the skin becomes scurvy, the medicine should be discontinued. The lump usually disappears slowly. Care should be taken that the other animals

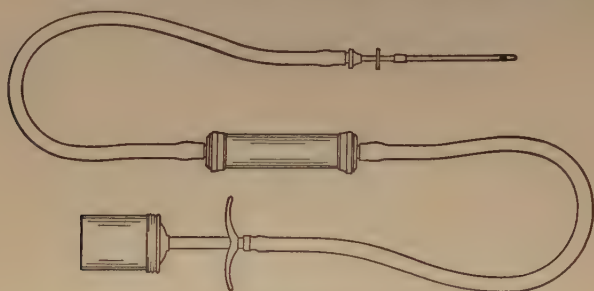


FIG. 95.—MILK-FEVER OUTFIT

An instrument used in treating cases of milk fever. The metal tube is inserted into a teat, and air pumped into the udder by means of the small air pump shown in the low part of the figure. The cylinder in the center contains absorbent cotton for removing dust from the air.

do not come in contact with an infected animal having a discharge. Provide laxative feeds.

MILK FEVER

Nature.—A disease affecting high-producing cows shortly after calving. The affected animal becomes unconscious and dies within a few hours if not treated.

Cause.—Not definitely known, but probably paralysis accompanied by changes in the circulation following calving.

Symptoms.—The disease usually occurs within two days after calving. The cow is restless and may thrash about wildly. After a time paralysis of the hind legs sets in, resulting first in an unsteady gait and finally in inability to rise. The cow lies with her head turned close to one side.

Treatment.—The treatment is very simple and, if given in time, effects a cure in a few hours in nearly every case.

Inflate the udder with air by means of a milk-fever apparatus (Fig. 95) or with compressed oxygen. Before using the apparatus, boil the milk tube for fifteen minutes or more and place fresh absorbent cotton in the cylinder. Wash the teats and the operator's hands in a disinfectant solution, and dip the



FIG. 96.—TREATING A COW FOR MILK FEVER

The kind of apparatus used is the same as that shown in Fig. 95.

milk tube of the apparatus in the solution also. Insert the milk tube into the teats, inflating each quarter in turn. If necessary, tie a wide strip of soft cloth lightly about the teat after inflation to prevent the escape of air.

The udder should remain inflated for twenty-four hours or more. If the air escapes during this time, reinflate. Do not milk the cow nor allow the calf to nurse while the cow is affected. Do not attempt to give medicine as it may choke the cow. Recovery usually occurs in twelve to twenty-four hours after treatment. Follow recovery with laxative feeds.

As a precaution against the occurrence of milk fever, during

the first two days after calving remove only enough of the milk from the udder to relieve the pressure.

PINK EYE

Nature.—A contagious disease causing inflammation of the eyes.

Cause.—A germ which may be transmitted from one animal to another.

Symptoms.—Intense inflammation of the membranes about the eyes, with a discharge which runs down over the face; swelling of the eyelids; closing of the eyes and partial blindness for a time. General symptoms are loss of appetite and reduced milk production.

Treatment.—House in cool, dark stable separate from other animals. Give a drench of Epsom salts. Wash the eyes several times a day with a solution of boric acid made by dissolving 4 drams ($\frac{1}{2}$ ounce) of boric acid in 16 ounces of boiling water and allowing to cool. If the treatment is given in time, the inflammation usually disappears in ten to fourteen days.

PNEUMONIA OF CALVES

Nature.—Inflammation of the lungs. It is very often fatal.

Cause.—The disease develops after a severe chill or as an accompaniment to white scours.

Symptoms.—A temperature of 105° or 106° F. or higher; rapid and shallow breathing; loss of appetite; constipation; a highly colored urine; dry skin, especially on the nose.

Treatment.—Consult a competent veterinarian. Blanket the calves and keep them in comfortable pens, free from drafts and dampness. In mild cases give a drench, such as 2 ounces of castor oil in a pint of milk; but in advanced cases give no medicine as a drench, as it may choke the animal. Upon recovery, animals are left weak and good care must be continued.

RETENTION OF AFTERBIRTH

Nature.—The membranes surrounding the fetus are not expelled after calving. If allowed to remain, they decompose, causing poisoning of the entire system and resulting in decreased milk production and often failure to breed.

Cause.—This is a very common occurrence in dairy cows, and is due to a variety of causes. Improper feed, such as an insufficient amount of feed, lack of minerals, moldy or spoiled feed, or overfeeding accompanied by constipation, may induce it. Drinking ice water or eating cold feed at the time of calving, chills, nursing of the calf or milking too soon after calving, may also be causes. This trouble usually accompanies abortion.

Symptoms.—If some of the membranes hang from the cow, the afterbirth is being retained. When retained, the membranes decompose, giving rise to a discharge having a very foul odor.

Treatment.—When due to the cow's being in poor condition or to chills, give a hot bran mash, a drench of Epsom salts to which has been added 1 ounce of ginger or half an ounce of black pepper, or hot drinks.

Introduce into the uterus, by means of a soft rubber tube and funnel, 2 to 3 gallons of a 1 per cent disinfectant solution or a salt solution made by adding 2 level tablespoonfuls of salt to a gallon of boiled water. After a short time, drain off the solution from the uterus by means of the rubber tube. Repeat every six hours. If not expelled within twenty-four hours after calving, the afterbirth should be removed by hand. For this work only a veterinarian or other experienced person should be employed, for injury to the organs may cause infection leading to fatal results. After removal, continue treatment for a few days with the solutions as directed above.

RINGWORM

Nature.—Circular patches on the skin, from which the hair falls out, and on which scaly crusts form. Occurs in winter or spring. May be contracted by man.

Cause.—A vegetable parasite.

Symptoms.—Small inflamed areas at first, usually on head or neck, later followed by slight discharges which form a scaly crust. The hair falls out from the affected areas. These areas may spread over a large part of the body. There is some itching of the affected parts.

Treatment.—Remove the crusts by washing with soap and water, then paint over the affected areas once daily for several days with tincture of iodine, sulphur ointment, or a solution of 1 part of carbolic acid to 20 parts of oil. Bathing the areas with a solution made by dissolving 2 ounces of copper sulphate in 1 gallon of boiling water has also been recommended.

It is well to disinfect the stable and whitewash it.

SCOURS, COMMON

Nature.—Looseness of the bowels of calves.

Cause.—Too large amounts of milk; irregularity in amounts or temperature of milk or time of feeding; feeding milk too rich in fat; feeding sour or dirty milk; the use of dirty pails.

Symptoms.—Loose or liquid discharge from the bowels; loss of appetite; gaunt appearance of the body.

Treatment.—Reduce the amount of milk fed to one-half. Mix $\frac{1}{2}$ ounce of formalin in a pint of water and add a teaspoonful of the mixture to each pint of milk fed for two or three days. Feed the usual amount of milk again as soon as improvement is noted. In mild cases, scalding the milk and then cooling to body temperature before feeding may correct the trouble.

In severe cases, give a physic of 2 ounces of castor oil in a pint of milk; and give in the milk, or place on the tongue two or three times daily, 1 teaspoonful of a powder consisting of 1 part salol and 2 parts subnitrate of bismuth. In addition, 1 or 2 ounces of lime water may be added to the milk at each feeding as a corrective.

SCOURS, WHITE

Nature.—Looseness of the bowels of calves, marked by a frequent discharge of nearly liquid dung which is dirty-white in color and has a very foul odor.

Cause.—An infectious organism which gains entrance through the mouth or raw navel of the calf.

Symptoms.—The nature of the discharge from the bowels is the most characteristic symptom. The course of the disease is very rapid; in a few hours the calf becomes too weak to stand, and it may die in one or two days.

Prevention and Treatment.—To help the calf in resisting infections of all kinds, it should have some of its mother's first or colostrum milk. The udder and teats should be washed with a disinfectant solution before the calf is permitted to nurse. If cases have occurred in the herd previously, care must be taken to clean and disinfect thoroughly the stalls in which calves are born. Burn or bury the bodies of all calves that die of the disease, and burn all the litter in the stalls. Treat the navel of the calf at birth with tincture of iodine.

The injection of white scours serum into the circulation soon after birth is a good preventive and may be used also when the first symptoms are noted. This treatment is expensive, however, and is justified only if the calves are valuable. Another kind of serum may be used in prolonged cases.

TEATS, CHAPPED

Nature.—Roughness of the skin on the teats, which develops into sores.

Cause.—Exposure to cold winds, especially if teats have been wet.

Treatment.—Soak in hot boric acid solution and rub dry. After each milking, apply carbolized vaseline or medicated salves sold for this purpose. If teats are very sore, a little of the salve placed on the palms of the hands before milking helps reduce the irritation.

TEATS, SORES AND SCABS OF

Nature.—Sores or scabs on ends of the teats, which make milking difficult.

Cause.—Injury by long fingernails, milking with wet hands, or dirty floors.

Treatment.—Soak in hot, saturated boric acid solution twice each day. Every other day, paint with tincture of iodine, or in bad cases use a mixture consisting of 1 part borax to 7 parts balsam of Peru.

TEATS, WOUNDS

Nature.—Wounds caused by tearing the teats on wire fences or by cows stepping on them, etc.

Treatment.—Treat at once with hot boric acid solution. Apply a disinfectant dusting powder, which may be purchased, at drug stores, in sifter-top cans, or may be made up as follows:

- 1 part iodoform,
- 1 part tannic acid,
- 4 parts boric acid.

If the teat is so badly torn that it can not be milked, disinfect a milking tube and insert it. Hold it in place by wrapping adhesive tape not too tightly about it. Usually the tape may be removed in about ten days. If the udder becomes hot, infection has set in. In this case, remove the tape and apply benzoated oxide of zinc ointment.

TUBERCULOSIS

Nature.—A disease affecting the lungs or almost any of the organs or tissues of the body.

Cause.—A specific germ which may be transmitted from animal to animal. Young animals may be infected by drinking milk from cows having infected udders.

Symptoms.—There are usually no outward symptoms until the disease is in its most advanced stages.

Treatment.—There is no known cure for the disease. The only certain method of finding whether or not the animals in the herd are affected is to have a competent veterinarian apply the tuberculin test. Any animals that the test shows to be affected should be sold for slaughter. In the case of valuable breeding animals, arrangements may be made, under proper supervision, to isolate them and use the milk for feeding animals after it has been thoroughly pasteurized or boiled.

One of the best ways of ridding a herd of tuberculosis is to apply to the Federal Inspector in Charge of Tuberculosis Eradication in your state to have the herd placed under Federal supervision.

As a preventive against introducing disease into the herd, any milk purchased from a creamery or cheese factory for feeding should be thoroughly pasteurized before being used. Furthermore, animals should be purchased only after having passed a tuberculin test and should be purchased subject to a retest made within sixty to ninety days.

UDDER, CAKED OR INFLAMED

Nature.—The udders of good dairy cows that are in high condition of flesh usually become inflamed and tender at calving. In severe cases, the udder pits on pressure.

Treatment.—Feed very lightly on concentrates until the inflammation disappears. Give laxative feeds, such as bran, roots, and alfalfa hay. The most effective treatment is milking three or four times daily, followed by thorough massaging of the udder with the hands for ten to fifteen minutes each time. Unsalted lard, camphorated oil, or cottonseed oil may be rubbed in, to help reduce the swelling.

UDDER, INFECTION OF, OR GARGET

Nature.—Inflammation of the udder, accompanied by an infection which changes the composition and appearance of the milk.

Cause.—An infectious organism. Indirect causes are lying on cold floors, cold drafts, or injury.

Symptoms.—Hardening of the udder, with inflamed appearance; lumps above the teats; thick stringy milk; high fever; loss of appetite. If not treated, the disease often results in the loss of one or more quarters of the udder.

Treatment.—It is best to consult a veterinarian. Treatment must be given at once. It consists in giving the cow a physic of Epsom salts and, after this has worked, $\frac{1}{2}$ ounce of saltpeter in the drinking water morning and night. Tincture of aconite in 10-drop doses may be given every three or four hours until four or five doses have been given. Pass a sheet around the udder and body of the cow to support the udder, cutting holes for the teats. Pack soft rags around the udder. Pour water, as hot as the hand can bear, on the rags every ten to fifteen minutes. After two hours of this treatment, dry the udder and rub on a salve made of 1 part mercurial ointment and 3 parts lanolin. Use this treatment twice a day.

Affected cows should be separated from the herd, and the hands of the milker thoroughly disinfected after milking.

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CHAPTER XVI

KEEPING BUSINESS ACCOUNTS WITH THE DAIRY HERD

The production of milk or cream for the market requires the use of good business principles if it is to be financially successful. Too often, no accounts of the cost of maintaining the dairy herd are kept. If a good living is secured from the farm business as a whole, it is supposed that the dairy herd is making a profit. There are many instances in which it would be more profitable to dispose of the herd and sell the farm crops than to continue to maintain the herd under existing conditions. A system of accounts, even though very simple, must be kept to determine whether or not the dairy herd is a profitable part of the farm business.

Operations:

1. Taking an inventory.
2. Keeping feed records.
3. Keeping records of purchases and miscellaneous expenses.
4. Keeping records of income from herd.
5. Calculating profit and loss.

1. TAKING AN INVENTORY

An annual inventory makes it possible to give credit to the herd for increases in the number or value of animals in the herd during the year. It is also a means of determining whether receipts from the sale of cattle are real returns from the growth

of the herd or whether such sales have resulted in decreasing the value of the herd.

Procedure:

A. Provide permanent record book.

B. Make an itemized list of property at beginning of each year.

A. Provide permanent record book.—Secure a bound record book for keeping the inventory and other business accounts of the herd. This may have only heavy paper covers, but the leaves should be bound together substantially so that it may be kept intact over a series of years.

B. Make itemized list of property at beginning of each year.—Make a list of all animals and equipment pertaining to the dairy herd, including the feed on hand, together with their values. Such a list is called an inventory. It should be made at the beginning of each calendar year (January 1) or annually at some convenient time, which is often March 1, in the case of tenant farms.

List each animal by herd number or name, and note its age and value. The values of the animals may be determined by several different methods. One is to compare your own animals with those sold at public sales. Another is to have two or three neighbors, who are familiar with prices of dairy cattle, come to the farm and set prices on the animals. Occasionally the services of a stock dealer may be secured. The milk records of the cows should be used, of course, in arriving at the value of the cows and their calves. The values of the calves are largely determined by the milk records of their mothers.

It is essential that the age of each animal be listed, for calves and heifers normally increase in value materially for a few years, while the older cows decrease in value with age.

Include in the inventory, also, the amount and value of feeds on hand, the value of the buildings used solely for housing the herd, and the value of special dairy equipment, such as milking machines, separators, feed grinders, tools, etc.

2. KEEPING FEED RECORDS

One of the largest sources of loss and the most important reason for lack of profits in keeping a dairy herd is the failure to feed cows in proportion to their needs. The keeping of a daily record of the production of the individual cows makes it possible to give to each cow the exact amount of feed needed; and if a record is also kept of the feed given to each cow, it can readily be determined not only whether the herd as a whole is making a good profit but also which of the cows are making the best profit and which may be causing an actual loss.

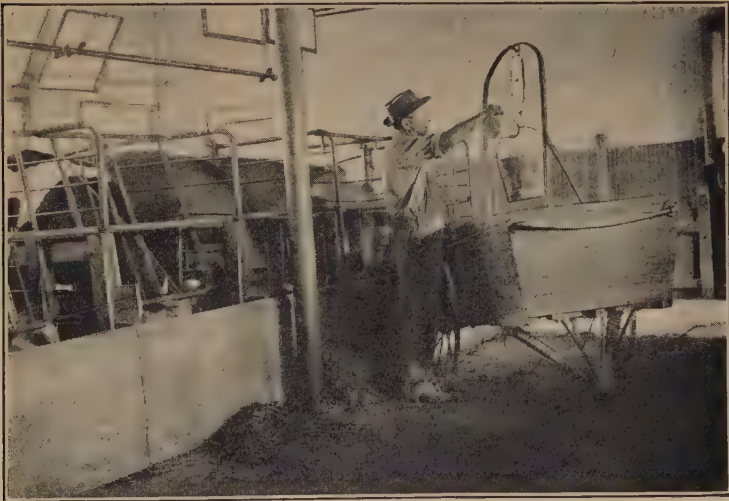


FIG. 97.—CAREFULLY WEIGHING THE GRAIN RATION FOR EACH COW

A feed cart of this type with a support for the scale facilitates the weighing of grain for the members of the herd.

Procedure:

- A. Secure or make feed-record blanks.
- B. Determine amount of feed given animals daily.
- C. Secure prices of feeds for month.
- D. Calculate cost of feed for each cow for month.
- E. Summarize records for the year.

Equipment:

Feed-record blanks, board, thumb tacks, two sheets of celluloid, large basket, washtub or box, platform scales or circular spring balance.

Month _____		FEED RECORD											
Cow No.		1			2			3			4		
Day of Month		Silage	Grain	Hay	Silage	Grain	Hay	Silage	Grain	Hay	Silage	Grain	Hay
1	A.M.												
	P.M.												
2	A.M.												
	P.M.												
3	A.M.												
	P.M.												
4	A.M.												
	P.M.												

FIG. 98.—PORTION OF A FEED-RECORD SHEET

The sheet may be extended to provide space for records for the entire month and for fifteen or more cows.

A. Secure or make feed-record blanks.—Secure a supply of feed-record blanks from some firm having them for sale (see references at end of chapter) or make some of your own by ruling sheets of heavy paper as shown in Fig. 98. The sheet for the current month may be kept in a glass case especially designed for the purpose, or it may be fastened to a board

by means of thumb tacks. If the latter method is used, the record sheet may be protected from being soiled by the hands or flies, by using two pieces of transparent celluloid in the same way as explained for the milk-production record. Each sheet should be about half the height of the record sheet and about 2 inches wider. These pieces are thumb-tacked to the board in such a manner that they are just wide enough apart to expose one day's space on the record blank.

B. Determine amount of feed given animals daily.—It is essential that the concentrates for each cow be weighed at each feeding, as explained in Chapter IX. This, of course, necessitates a feeding chart or guide kept conveniently near the weight balance. This chart may be a temporary sheet attached to the feed chart, or it may be the regular monthly feed sheet. If a temporary sheet is used, copy the amounts from it to the monthly record.

Calculate, from the daily entries of the amounts of grain mixture fed, the amounts of each of the constituents, such as bran, oats, corn, etc., that have been fed each day, and enter the amounts in the proper columns.

If hay is not weighed regularly, weigh the amount fed each cow during one day and use this as the average daily amount for the month. To weigh the hay, place a large basket, wash-tub, or box on a platform scale; if the scale has a double beam, use the weight on one of the beams to balance the basket, tub, or box. Then use the other beam for weighing the hay for each cow. In case a considerable portion of the hay fed remains uneaten, it should be weighed back and the weight recorded. Silage may be weighed in the same manner as the hay, preferably in a galvanized iron bushel basket.

In case no platform scale is available, a circular spring balance having a capacity of 60 pounds, such as the type used for weighing milk, may be used for weighing hay and silage. When such a balance is used, roll the hay into a bundle, tie with binder twine or cord, and hang on the scale hook. To weigh the silage, tie a small rope from handle to handle of the basket,

leaving a little slack, and suspend the basket by slipping the rope into the scale hook. Be sure to deduct the weight of the empty basket from the weight shown on the scale, or set one of the scale hands to read zero when the empty basket hangs on the scale.

C. Secure prices of feeds for month.—Consult the local feed dealer or elevator manager in regard to prices of grain, mill feed, and hay for the month. In case the prices can not be obtained in this manner, they may be secured from farm papers or from one of the publications listed in the references at the end of this chapter.

Corn silage is a perishable product, which must be fed near the place where it is produced. There is, therefore, no price for it based upon demand and supply on the market. A price, which represents very closely its value compared with that of other feeds, may be calculated as follows:

Find the value of 4.6 bushels of shelled corn at local market price, less the cost of marketing.

Find the value of 270 pounds of mixed hay at the local market price, less the cost of marketing.

The sum of the two above values represents the farm value of one ton of corn silage.

D. Calculate cost of feed for each cow for month.—Multiply by their respective prices the amounts of the various feeds consumed during the month by each cow in the herd. Add the costs for the different feeds, to obtain the total feed cost for the month for each cow.

E. Summarize records for the year.—Copy from the twelve monthly feed sheets the cost of feed for each month, and total the items. These totals should be entered on a separate summary sheet ruled to hold summaries of yearly feed cost and value of milk or butterfat for each of the cows in the herd.

3. KEEPING RECORDS OF PURCHASES AND MISCELLANEOUS EXPENSES

Every expense incurred in connection with the herd should be promptly and accurately recorded in order that the true cost of production may be determined.

Procedure:

- A. Record purchases of livestock.
- B. Record feeds bought.
- C. Record labor and miscellaneous expenses.

A. Record purchases of livestock.—Whenever an animal is purchased, record the date of purchase, name of seller, name and herd number of the animal, age, and price paid, plus any transportation charges. Such a record helps greatly in making up the inventory at the end of the year.

B. Record feeds bought.—List each purchase of feeds, giving date, amount, and cost. Sometimes it is not possible to keep individual feed records for each cow. In such cases, a record of the amount of feeds purchased, together with the amount and value of those produced on the farm, may be used to estimate roughly the profit or loss in feeding the herd. Include in this list purchases of salt or other mineral feeds.

C. Record labor and miscellaneous expenses.—Estimate the amount and value of labor expended on the care of the herd each month. When hired labor is used for both the care of the herd and other farm work, estimate the proportion of the workers' time spent in caring for the herd, and charge the herd with a proportionate part of the wages paid.

Record also miscellaneous expenses, such as new equipment purchased.

4. KEEPING RECORDS OF INCOME FROM HERD

Similarly all receipts from the sale of dairy products, livestock, etc., and the value of all dairy products consumed on the farm or in the home, should be carefully recorded.

Procedure:

- A. Arrange suitable record book.
- B. Keep record of dairy products used at home.
- C. List each sale of dairy products.
- D. List each sale of livestock.
- E. Record miscellaneous receipts.

A. Arrange suitable record book.—Arrange a page in your record book for entries of the sales of milk and cream. Rule the page vertically, providing columns for the date, farm to which sale was made, amount of milk or cream, the test, price, and total amount of sale. Arrange another page, headed "Milk and Cream Used at Home," for entries of the amount of milk and cream used by the family each week or month, using column headings similar to those given above. Provide a third page, headed "Milk Fed," with columns showing date, whole milk, skim milk, amount, value per hundredweight, and total value. Set aside another page for sales of livestock and one for miscellaneous items.

B. Keep record of dairy products used at home.—Provide a sheet in the barn for keeping account of the amount of milk and cream taken to the house for family use, or sold to the hired help, and of the amount of whole milk and skim milk fed to calves or other livestock. Columns for these entries may be made on the milk-record sheet on which the daily milk records of each cow are kept, or on a separate sheet ruled for the purpose.

Weigh or measure the amount of milk and cream used by the family and hired help, and record the amount. If it is not possible to do this each day, make the measurement one day

each week and from this estimate the amounts used weekly. If the milk and cream are measured in quarts, the amounts may be converted to pounds by multiplying the number of quarts by 2.15.

Weigh or measure the amount of whole milk and skim milk fed to calves. If the milk for each calf is weighed at each feeding, as directed in Chapter XI, the total amounts fed daily can be found readily by totaling the amounts fed the different calves. Do not include in this record any milk that is obtained from cows during the first eight milkings after calving, as such milk is not considered fit for sale.

When the cream is separated and the skim milk fed to pigs, the skim milk may be weighed after separating and the amount recorded. In case a platform scale for weighing is not available, the amount of skim milk may be estimated from the weight of the whole milk, assuming that the skim milk forms 80 per cent of the whole milk. The weight of the whole milk may be estimated, in turn, by totaling the individual milk yields of the cows and assuming that each gallon weighs 8.5 pounds, or each 8-gallon can contains 68 pounds and each 10-gallon can 85 pounds.

When cream is churned on the farm and the buttermilk fed to livestock, the weight of the buttermilk may be estimated as 65 per cent of the weight of the cream churned.

C. List each sale of dairy products.—Each time that a check or cash is received from a sale of milk, cream, butter, or other dairy products, make an entry of it in your record book, being careful to include the test of milk or cream if payment is made upon a butterfat basis. Total the amounts received during each month.

From the barn records, compute the total amounts of milk, cream, and skim milk used for food or fed to livestock other than calves during the month. The milk and cream should be valued at the average price received for the milk and cream sold during the month, and the amounts listed under household or hired help use.

The value of skim milk may be estimated in different ways. If there is a market for both whole milk and butterfat, the value of the skim milk may be estimated as the difference between the market value of 100 pounds of whole milk and the value of the butterfat in 100 pounds of milk. For example; if whole milk is selling for \$2.25 per hundredweight and butterfat for 48 cents per pound, milk testing 3.5 per cent fat would be valued at \$1.68 on the butterfat basis ($3.5 \times \$48 = \1.68), and



FIG. 99.—“THE LOWING HERD WINDS SLOWLY O’ER THE LEA”

the difference between \$2.25 and \$1.68, or \$.57, would be the value of the skim milk (80 pounds) derived from 100 pounds of whole milk. The value of the skim milk per hundredweight would therefore be $\frac{$.57}{.80} = $.71$.

In the absence of a market for whole milk, the value of skim milk per hundred pounds may be estimated as one-half the market price of corn per bushel.

D. List each sale of livestock.—Record each sale of an animal from the herd, including the date, name or herd number of the animal, the name of the purchaser, and the selling price. Unnamed calves may be designated by using the name of the calf's mother, followed by the letter *s* or *d* (son or daughter), depending upon the sex of the calf.

E. Record miscellaneous receipts.—Make entries of sales of miscellaneous character, such as hides, bull services, etc.

5. CALCULATING PROFIT AND LOSS

It is customary on many dairy farms to attempt to determine whether or not the herd is profitable by comparing the cost of the feed given each cow with the value of the milk she produces. Such a method gives valuable information, since the cost of feed usually forms 70 per cent or more of the total cost of milk production. It has the advantage of determining the relative profitableness of each cow, but does not take into consideration increases or decreases in the value of the herd and the cost of labor, which may be large items.

A more complete method is outlined below. It is not so detailed as most cost accounting methods, but it may be used with approximate accuracy.

Procedure:

- A. Prepare statement of business for the year.
- B. Determine difference in inventory totals.
- C. List total receipts and credits
- D. Itemize expenses.
- E. Find totals.

A. Prepare statement of business for the year.—Prepare a summary sheet with columns for receipts and expenses.

B. Determine difference in inventory totals.—Compare the inventory taken at the beginning of the year with that taken

at the close. Be sure that cattle purchased during the year are included in the final inventory. Compute the difference, if any, in the value of the herd at the beginning and at the end of the year. If there has been an increase, place the amount of the increase in the receipt column, and if a decrease, list the amount as an expense.

C. List total receipts and credits.—List the total receipts from sales, the value of dairy products used by the family and help, and the value of milk fed to livestock other than calves.

Compute the amount of credit due to the herd for manure produced, and list this as one of the receipts. To calculate the value of the manure, determine the average number of animals over two years of age, and the number under two years, in the herd during the year. Credit each animal over two years of age with 12 tons of manure valued at \$.75 to \$2.50 per ton (\$1.50 being a fair estimate) and the animals less than two years of age with one-half that amount.

Another method of arriving at the value of the manure is to keep account of the number of loads of manure produced by the dairy herd during the year. The loads may be valued at \$.75 to \$2.50 each, \$1.00 being a figure in common use.

D. Itemize expenses.—List all of the expenses for feed, labor, etc., that have been paid in cash, as well as the value of feed, including pasture, raised on the farm and consumed by the herd, and unpaid labor. Include also the value of straw, or other material used for bedding, that is produced on the farm.

The value of pasture is rated at \$1.50 to \$3.00 per month per cow, and at one-half as much per head of young stock. The value varies greatly, depending upon the price of other feeds, quality of the pasture, and the price being received for dairy products. Corn stalk pasture is rated at \$1.00 to \$2.00 per acre.

Charge the herd with the use of buildings, tools, and equipment at the rate of 5 per cent of the value of the buildings and equipment actually used in connection with the herd, and interest on the value of the cattle at 5 per cent.

E. Find totals.—Total the expenses and also the receipts, and find the difference between the two. The results may be expressed in different ways. One method is to divide the total profit by the number of milking cows in the herd and express the results as profit per cow. Another is to compute the returns on the investment in buildings, equipment and cattle, in this manner:

$$\frac{\text{Difference between receipts and expenses}}{\text{Total investment}} \times 100$$

= per cent returns on investment.

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COMMUNITY STUDIES

Learn the names of several farmers in the community who are keeping business accounts with their herds. If no such farmers are known, consult the county farm adviser or write the agricultural experiment station of your state to find out if any farmers are keeping cost records under their direction. Make arrangements to visit such farms and ask the owner or manager to explain his methods of keeping accounts.

1. How is the annual inventory taken and of what does it consist?
2. How are the values of the different animals in the herd determined?
3. Upon what kind of a form are feed records kept?
4. Are feeds weighed and recorded daily, once weekly, or once monthly?
5. How are the values of the feeds (including pasture) determined?
6. How are records of income from the herd, such as sales of milk, cream, livestock, etc., kept?
7. Is the value of dairy products used in the home taken into account?
8. How is the value of the skim milk fed to pigs determined?
9. In summing up the business of the herd for the year, what items are included in the receipts and what items in the expenses?
10. What were the total returns and total expenses for the past year?
11. What were the net returns per cow, calculated on the basis of the average number of cows milked during the year?
12. What were the net returns from the herd in terms of percentage of the total investment in the herd?

CHAPTER XVII

FITTING ANIMALS FOR SALE AND EXHIBITION

In the buying and selling of cattle there are no definite standards of value nor well-established grades or brands to be used for comparisons, as in the marketing of most other commodities. The price that an animal will bring, therefore, is largely a question of the personal opinion of the individual who is in the market to buy, and his willingness to agree on a price will depend to no small degree upon what he can see in the animal. Realizing this fact, the successful dairyman will spare no pains to fit his cattle in such a way that they will create the most favorable impression in the mind of the prospective purchaser.

The same care must be used in preparing animals for exhibition at fairs and shows. Breeders generally are recognizing that the value of advertising by exhibiting depends largely on the favorable impression made in the visitor's mind by the appearance of the cattle. The selecting, fitting, and showing of animals deserves special study, since it can mean so much to the name and fame of a herd.

Operations:

1. Selecting animals.
2. Training animals to lead and pose.
3. Putting animals into condition.
4. Fitting for show.
5. Shipping animals.
6. Making the final preparations.
7. Showing a spirit of sportsmanship.

1. SELECTING ANIMALS

Great care should be exercised in the choosing of animals for exhibition. Breeders have been known to leave their best animals at home, either because they were not familiar with the most acceptable type or because they had personal preferences which prejudiced them for or against an individual.

Procedure:

- A. Examine all animals in the herd.
- B. Select animals that are well developed for their age.
- C. Pay special attention to straight topline and long, level rumps.
- D. Among milking animals, choose those with well-shaped udders.
- E. Select for refinement with ample feeding capacity.
- F. Reject animals with any serious defect.

A. Examine all animals in the herd.—Even though you may be familiar with all the animals in the herd, use extreme care in going over each individual that might be considered as suitable for exhibition. Do not permit a personal liking for an animal to influence you in making your selections. Be guided only by actual facts.

B. Select animals that are well developed for their age.—Animals placed on exhibition are usually somewhat larger than the average for the breed. In selecting animals for exhibit, therefore, choose only those which are well grown and at least equal in size to the average expected for the age and breed. Extremely small animals, even though they may be especially smooth and fine in type, are undesirable for exhibit; on the other hand, unusually large animals are often coarse and unsymmetrical and should be rejected.

C. Pay special attention to straight topline and long, level rumps.—Breeders and judges uniformly demand straight backs and long, level rumps. Animals having uneven or badly

sloping rumps, even though especially good in all other points, are rarely acceptable for exhibition purposes.

D. Among milking animals, choose those with well-shaped udders.—The udder of a dairy cow should always be given much consideration in selecting animals for breeding or exhibition purposes. Udders are most desirable when they are attached high and wide in the rear and are carried well forward and held snugly to the body in the front. The quarters of the udder should be equally developed. The teats, when most desirable, are evenly placed a good distance apart from side to side and from front to back.

E. Select for refinement with ample feeding capacity.—Choose an animal with a head that shows finely chiseled features and graceful lines, a neck that is long and slender, and withers and shoulders that show quality and refinement. The muzzle should be well developed and strong, indicating desirable feeding capacity, and the nostrils should be large and well distended. There should be ample spring of rib, especially of the upper rib, and the body preferably should be long and deep.

F. Reject animals with any serious defect.—Even though an animal is otherwise acceptable, do not attempt to exhibit it if it has a serious defect, such as one-quarter of the udder not functioning (blind), a badly sloping rump, decided lameness, blindness, or any serious bodily defect.

2. TRAINING ANIMALS TO LEAD AND POSE

Excellent animals are frequently disappointments when on exhibition because they have not been taught to lead properly or to take and hold a desirable position for a reasonable length of time.

Procedure:

- A. Teach animal to lead readily.
- B. Train animal to back.
- C. Train animal to hold a good pose.

A. Teach animal to lead readily.—Animals, both male and female, should be taught to lead when they are relatively young. They learn more quickly then and are usually much easier to handle than when older. While walking, the animal should hold its head directly in front, with the poll several inches higher than the withers.



FIG. 100.—COW SHOWING EXCELLENT POSE

Fine-type Holstein cow in remarkable pose, with head carried high, ears pointed forward, tail flowing backward, carriage alert, posture suggesting forward movement, and front and rear of udder both showing.

B. Train animal to back.—The animal should be trained to back by having a slight pressure put on its shoulder. The attendant can then make the animal take a desirable pose in close quarters, either by leading it forward a step or by backing it into position.

C. Train animal to hold a good pose.—The good points of an animal will show off to much better advantage in the judging

ring if it has been taught to stand well. Teach it to take a good position, standing squarely and naturally on its feet with head well up and ears extended forward. Study the poses that show off its good points and train it to hold them as long as desired. Fig. 100 illustrates such a pose.

3. PUTTING ANIMALS INTO CONDITION

To present the best appearance, an animal must carry a sufficient amount of flesh to cover the skeleton smoothly and show vigor and capacity. Too much fat tends to make even a good dairy animal look beefy.

The length of time required to get an animal into proper condition will depend upon the following factors: age, sex, period of lactation (in the cow), and original condition.

Young animals are usually more easily and quickly fitted than older ones. Heifers in most cases can be put into proper condition in sixty to ninety days. Cows should be in good flesh at calving time, and for this reason show best about this time. A cow with a good udder but lacking in body shows best just before calving, whereas one that is naturally deep in body but lacking in dairy tendency shows best after she has been in milk for a short time. Bulls, especially old bulls, generally require a longer time for fitting than do cows.

Procedure:

- A. Keep animals to be exhibited in a cool barn free from flies.
- B. Feed liberal amounts of a good grain ration.
- C. Avoid excess fat and accompanying patchiness.

A. Keep animals to be exhibited in a cool barn free from flies.—It is almost impossible to get an animal into proper condition, especially during the hot summer months, if it is running at pasture. Place all animals to be exhibited

in as comfortable quarters as possible, and exclude flies by covering the doors and windows with burlap or other material.

B. Feed liberal amounts of a good grain ration.—Use the following grain ration for conditioning animals:

- 100 lbs. ground oats
- 200 lbs. hominy or ground corn.
- 100 lbs. bran.
- 100 lbs. oil linseed meal.
- 5 lbs. salt.

The amount of this mixture to feed depends upon the condition of the animal and the length of the feeding period. Very thin animals should be fed about all they will clean up readily after having had free access to roughage. Well-fleshed animals require only enough grain to put them into proper condition. When feeding bulls, mix the grain ration with water or molasses until it forms a slop. This method of feeding tends to develop a deep body which gives evidence of greater capacity. Furthermore, most animals, either young or old, will stand shipping better if they have been given slop feed.

C. Avoid excess fat and accompanying patchiness.—Care must be taken not to get the animals in too heavy flesh, or they may become patchy; that is, fatty deposits may appear about the tailhead or other parts of the body. When the animals are in proper condition, and before there is evidence of any patchiness, lighten the ration by putting in more bran and oats. At the same time reduce the amount of corn or hominy and oil meal as well as the total amount fed. Usually, animals that are too well fitted at the beginning of a show season "go bad" before the later and more important shows.

4. FITTING FOR SHOW

The skilful exhibitor pays careful attention to every detail in clipping, washing, blanketing, and preparing his animal for the ring.

Procedure:

- A. Clip animal carefully, if necessary.
- B. Wash animal thoroughly before each exhibition.
- C. Keep animal blanketed.
- D. Smooth and polish horns.

A. Clip animal carefully, if necessary.—It is not advisable to clip an animal over the entire body unless the hair is extremely long and rough and the time for fitting is short. Do not clip animals that are thin in flesh, as clipping tends to make them look thinner. When clipping is necessary, it should be done six to eight weeks before the first show, except in the case of young, well-fleshed animals, when it may be done later. When the condition of the hair over the body is satisfactory, clipping should be done only on the underline (except in the Ayrshire breed), on the neck and head, the tail, and occasionally along the higher processes of the back and over the withers. It is the custom of Ayrshire breeders to clip only the heads, necks and tails of their exhibition animals.

In clipping the tail, do not clip too low on the switch as this detracts from the appearance and symmetry of the animal. Irregularities on the back may be made less conspicuous by clipping the hair short on the high spots and leaving it unclipped over the depressions. If withers are to be clipped at all, they should be clipped from both sides in such a way that their sharpness will be accentuated.

B. Wash animal thoroughly before each exhibition.—In summer, wash in cold water. When the weather is cool, it is advisable to use warm water. Wash over the entire body. Use a good soap. "Grandpa's Tar" soap is excellent for two or three washings, but with repeated use it tends to darken the white portions. Washing with "Lux" will avoid this difficulty.

Rinse the animal well and remove the excess water with a scraper made of a smooth piece of wood, with or without a rubber edge. Complete the drying-out process by covering

the animal with a light-weight blanket. Wool bed blankets are best for this purpose. In cool weather, use a lined stable blanket in addition. In warm weather the wool blanket should remain on the animal approximately two hours or until the animal is dry; in cool weather it may be left on longer.

C. Keep animal blanketed.—The continued use of a blanket on an animal to be exhibited prevents soiling and staining, and



FIG 101.—GUERNSEY BULL IN THE ROUGH

Observe the general lack of thrift, and the long, uneven coat of hair with bare spots over withers and rump.

makes the hair lie down more smoothly. It protects the animal against drafts and sudden changes in temperature, and in summer against flies and insects. A light-weight duck or burlap blanket is best for this purpose. In cool weather it may be desirable to use two blankets, such as the ordinary stable blanket with a flannel blanket underneath.

D. Smooth and polish horns.—Dairy cattle show to the best advantage when they have shapely horns. In the case of certain breeds, notably Holstein, judges do not discriminate against females that have been dehorned. Bulls of any breed appear best with horns. When horns are too long, from $\frac{3}{4}$ to $1\frac{1}{2}$ inches of the tip may be removed. In long slender horns, the latter amount can usually be removed before the sensitive tissue



FIG. 102.—GUERNSEY BULL AFTER FITTING FOR SHOW

Photograph taken ten days later. Note the thrifty, healthy appearance of the animal and the smooth, even coat of hair. In this case clipping was done over the entire body.

is reached. In the broader type of horns, it may not be possible to remove so much.

Large horns and those badly marred should be scraped or rasped down until they are smooth and shapely. A small wood rasp is usually best for this purpose. Any marred places that

still remain may be taken out with a horn scraper or a piece of glass. After the horns have been rasped, they should be smoothed with emery cloth, first with the coarse cloth and later with the fine.

Upon the smooth surface of the horn, place a thin coating of tripoli powder and sweet oil mixed to the consistency of a thin paste. Polish with a strip of flannel cloth. Two or three such applications and rubbings should bring out a very high polish. When time is limited, horns that have previously been smoothed down and polished may be given a thick coating of olive oil. This gives a glossy polish, especially at night, but such a polish will not last for more than half an hour.

5. SHIPPING ANIMALS

It is especially important that animals arrive at the exhibition grounds in the best possible condition. Much of the result of careful fitting can be lost in a single shipment if animals are not properly cared for when in transit.

Procedure:

- A. Ship by freight.
- B. Select ventilated car.
- C. Disinfect car before loading.
- D. Obtain necessary pails and equipment.
- E. Carry ample feed and water in car.

A. Ship by freight.—It is usually advisable to ship exhibition animals by freight, accompanied by an attendant. The cattle usually stand the trip better, the cost is generally less, and facilities for making shipment are more readily obtainable than if shipment is made by express. For short distances, however, animals may be transported satisfactorily by truck. Young animals or individuals that are not milking may be shipped by express without an attendant.

B. Select ventilated car.—If possible, select a car that can be ventilated, preferably one with end doors. In hot weather, a good circulation of air is especially necessary in order to keep the animals comfortable.

C. Disinfect car before loading.—Except in the case of a new car which has not been used for cattle shipments, it is always advisable to disinfect the car thoroughly before loading cattle into it. Any of the ordinary disinfectants, such as carbolic acid, cresol, etc., are entirely satisfactory for this purpose. These materials may be sprayed or washed on the sides and bottom of the car.

D. Obtain necessary pails and equipment.—Always provide your own pails and equipment. The practice of borrowing and lending pails is especially undesirable as it tends to spread disease.

E. Carry ample feed and water in car.—Cattle do much better if feed and water are supplied while they are in transit. It is always a good plan to take more feed and water than will probably be required, as accidents and delays frequently occur.

6. MAKING THE FINAL PREPARATIONS

The careful showman spares no pains to assure himself that his animals are comfortable and are being properly prepared for exhibition.

Procedure:

- A. Braid switches.
- B. Withhold water.
- C. Bed down heavily.
- D. Clean animals thoroughly and get equipment in readiness.
- E. Feed carefully.
- F. "Fill," to desired fulness.
- G. Give horns final polish, and rub down hair.
- H. Exhibit animal to best advantage in the ring.

A. Braid switches.—The evening before the exhibition, wash the switches of the animals thoroughly with soap and water and then dip them into a pail of water to which has been added a small handful of powdered alum. Alum water tends to make the tail fluffy when combed out for exhibition. Braid the switch into a number of small braids, and wrap these braids together with a cloth to prevent soiling.

B. Withhold water.—The evening before the show, do not allow animals that are to be exhibited to have access to water. The purpose in withholding water is to make reasonably sure that the animals will take on the desired "fill," at the time of exhibition. As an added stimulant to thirst, a double handful of salt should be given to each animal the night before the show.

C. Bed down heavily.—While animals should be well bedded at all times, it is especially important to keep them clean the night before the show. Oftentimes an attendant is on duty during the night preceding the show, to remove the soiled bedding.

D. Clean animals thoroughly and get equipment in readiness.—On the morning of the show, animals should be cleaned thoroughly. In the case of milking animals, the udders should be eased off preparatory to bagging. This will tend to prevent "hiving," or the skin rising up in small welts over the body. At this time, also, get in readiness such equipment as halters, lead straps, bull staffs, etc. Pails should be filled with water, properly tempered, in readiness for use when animals are filled.

E. Feed carefully.—On the morning of the show, do not give a large quantity of feed at one time, as this tends to make animals sluggish. Small amounts of grain fed at frequent intervals, together with the animals' desire for water, will tend to keep them alert.

F. "Fill" to desired fulness.—About an hour before an animal is to go into the ring, it should be given water. If the weather is cold, take the chill from the water; otherwise the animal will hump up its back and shiver. Too much water is to be avoided as it tends to distort the appearance of the body and

makes the animal difficult to show. Take charge of this operation yourself. It should not be left to a stable boy who does not know when the animal is properly filled.

G. Give horns final polish, and rub down hair.—Immediately after the animal is “filled,” the horns should be given their final polish, the hair should be rubbed down, and the show halter put on. The animal is now ready for the ring.



FIG. 103.—HANDLING AN UNRULY BULL IN THE SHOW RING

A heavy leather harness passes around the chest and is attached to the horns and nose ring in such a manner that the bull can not lower his head. The bull is led by two men, one using the staff and the other (at the left of the picture) a rope attached to the nose ring.

H. Exhibit animal to best advantage in the ring.—An animal should appear at its best at all times when in the ring. If it has been well trained, it can be made to take and hold the various positions which have been studied out as showing its good points to the best possible advantage. While in the ring, keep your eyes on both the judge and the animal. When a meritori-

ous animal is not being noticed by the judge, the exhibitor can sometimes attract the attention of the judge by moving his animal into a more advantageous position.

7. SHOWING A SPIRIT OF SPORTSMANSHIP

Learn to recognize and appreciate merit in another's animals. Do not be discouraged when your animals do not win. Remember that opinions differ and that if you really have good animals and are showing them to advantage they will be appreciated.

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CHAPTER XVIII

PLANNING AND EQUIPPING THE DAIRY BARN

A conveniently arranged dairy barn not only reduces to a minimum the labor of feeding and caring for the dairy herd, but also makes the work much pleasanter. Moreover, if the barn is to be sanitary and the cattle are to be kept in good health, it is essential that good systems of lighting and ventilation be provided.

As a man seldom builds a dairy barn for his own use more than two or three times during his lifetime, it is wise, in making plans, to take advantage of those principles which have been generally adopted by good dairymen. The chief of these principles are discussed below. For detailed plans showing standard types of construction, consult your state agricultural experiment station, the Bureau of Dairying of the U. S. Department of Agriculture, or barn equipment companies that have barn-plan service departments.

Operations:

1. Planning the barn.
2. Equipping the barn.

1. PLANNING THE BARN

Much thought should be given to the location and plan of the dairy barn. Both the convenience of the attendants and the comfort and well-being of the animals should be taken into consideration.

Procedure:

- A. Select best site available.
- B. Choose type of barn to meet your conditions.
- C. Calculate size of barn required.
- D. Decide upon arrangement and construction of stalls.
- E. Plan for housing of young stock.
- F. Plan for maternity pens.
- G. Provide sufficient light.
- H. Arrange for a good ventilation system.
- I. Include a suitable milk room.
- J. Arrange convenient exercising yards.

A. Select best site available.—Study the arrangement of the other farm buildings, the slope of the ground, the direction of the winter winds, and the possible location of exercising yards, in order to select the best possible site for the dairy barn. As convenience in getting work done is one of the most important factors, location of barn with reference to other buildings is generally of first importance. Good natural drainage for barn and lots is very desirable. When this can not be secured, employ artificial drainage and grading, if possible, so that water will drain away quickly from the barn and yards. Locate the barn so that it will form a windbreak for at least one side of the exercising yards.

Consider also the possible future location of a silo and milk house so that they will be convenient to the barn and so that the milk house will also be convenient to the water supply.

B. Choose type of barn to meet your conditions.—Before drawing plans for your barn, study the many different types of dairy barns in use. Read the discussion and note the illustrations of different types of barns as given herewith. Visit some of the barns on the best dairy farms in your community; or, if there are no good examples of modern construction among the neighboring farms, consult your farm adviser or write your agricultural experiment station to help you locate some. Write some of the barn equipment companies for their books of general

plans. From the observations and information thus gained, choose the type that seems best suited to your conditions.

Different types of dairy barns are found prevailing in different communities or sections of the country, as the result of the character of the land, the need for storage space, or community preferences. The following are some of the more common types:

The *two-story, or loft, barn* (Fig. 104) is suitable for a level country where driveways to the mow floor are not common.



FIG. 104.—TWO-STORY TYPE OF FRAME DAIRY BARN

The litter carrier is so arranged that it may be emptied directly into the manure spreader.

A barn of this type can be readily lighted and ventilated, provides hay storage convenient to the cattle, and is generally one of the best suited for housing dairy cattle.

The *basement, or bank, barn* (Fig. 105) is common where the ground is rolling or hilly. One side of the barn is built next a bank and a driveway leads to the second floor. Such barns are generally very poorly lighted on the side next the bank, and, on account of masonry construction of the basement, tend to be damp. Barns of this type are satisfactory when provided with sufficient light and good ventilation.



FIG. 105.—A GOOD EXAMPLE OF A BASEMENT DAIRY BARN

The barn has heavy masonry walls with few windows. A milk house adjoins the barn at the left. Note the covered rack for milk cans.



FIG. 106.—A ROUND DAIRY BARN

A silo is located in the center of the barn, and the stalls are arranged in a circle facing the silo. The round barn affords great convenience in feeding.

The *round barn* (Fig. 106) of moderate size (not exceeding 60 or 70 feet in diameter) is a type that is also readily lighted and ventilated. The first floor can be very conveniently arranged for the care of cows in stanchions. The round barn has several limitations, such as the difficulty of using a hay carrier, weakness of construction, etc., and therefore is preferred by but few dairymen.

The *one-story barn* (Fig. 36) is preferred by some dairymen who are making a specialty of high-grade milk. Barns of this type have no feed storage above the cows, the feed being kept in another building which may be either separate or closely connected with the cow barn. This type of barn is suitable for warm climates where strong construction and ceilings are not needed. Windows or ventilators may be placed near the ridge so that they quickly carry off the warm air.

The *covered barnyard* (Fig. 107) connected to a milking barn is occasionally used. The milking barn may be large enough for all or for only a part of the cows in the herd. The cows are kept in the barn only while being milked and fed silage and grain. Dry roughage is fed in racks in the covered yard. From 50 to 65 square feet of floor space per cow is required in the yard. Large amounts of bedding must be provided in the yard in order to keep the cows clean. This plan of housing dairy cattle is used on relatively few farms.

C. Calculate size of barn required.—The usual arrangement of cows in dairy barns is two rows of cows lengthwise of the barn. This requires, in a barn of frame construction, an outside width of 34 to 36 feet. If heavy masonry walls are used, 2 feet more should be allowed.

The length of the barn is easily calculated from the number of cow stalls, each stall usually being about 3 feet 6 inches in width. Allow 4 feet in addition for walks at each end of the barn; and if more than twenty stalls are in a continuous row, allow 3 feet for a cross alley through the middle of the barn. It is best to draw the floor plan first, arranging the stalls, pens, walks, etc., as desired, and from this plan determine the size

of the barn necessary. Do not choose definite outside dimensions first and then expect to be able to make the interior arrangements ample and convenient.

D. Decide upon arrangement and construction of stalls.—Consult dairymen who have herds about the size of yours, in regard to the best arrangement of the stalls. Experience has shown that for the best lighting and the greatest convenience in



FIG. 107.—INTERIOR OF A COVERED BARNYARD

After the cows are milked they are turned loose in this covered yard, where they consume roughage from the racks. Feed and bedding may be brought in by wagon, and manure removed by loading directly into a manure spreader.

caring for the cows, dairy barns should be wide enough to accommodate two rows of stalls arranged lengthwise of the barn.

Two arrangements of the stalls are common. In one plan the two rows of cows face each other, or "face in," as it is termed; in the other plan the rows of cows face the side walls, or "face out." Both plans have many advantages and some disadvantages.

The stall should be planned to give the cow a comfortable place to stand and lie down, and should be of such length that

the droppings will fall in the gutter and not on the stall platform.

Since the breeds of cattle differ in size, both the length and the width of the stall should be planned for the breed to be housed. Jerseys and Guernseys require a platform 4 feet 4 inches to 4 feet 10 inches in length and 3 feet to 3 feet 8 inches in width. Holsteins, Brown Swiss, and Ayrshires require a plat-



FIG. 108.—LARGE DAIRY BARN IN WHICH COWS FACE OUT, THAT IS, TOWARD THE WALLS

The manure is removed by loading into a manure spreader driven through the barn.

form 4 feet 8 inches to 5 feet 4 inches in length and 3 feet 6 inches to 4 feet in width.

The cows in a herd usually differ in size, the two-year-olds being much smaller than the mature cows. For this reason, stalls of different sizes should be provided. This can be done by varying the length of the platform throughout the barn, as shown in Fig. 109, and by having the stalls narrower where the platform is shortest.

The floor of the stall should slope from $\frac{1}{2}$ inch to 1 inch toward the gutter.

When little or no bedding is used in the stalls, concrete floors are cold and damp, particularly in northern climates. Various means are used to remedy this objection, since concrete construction is especially desirable in the cow barn because of its durability and sanitary features.

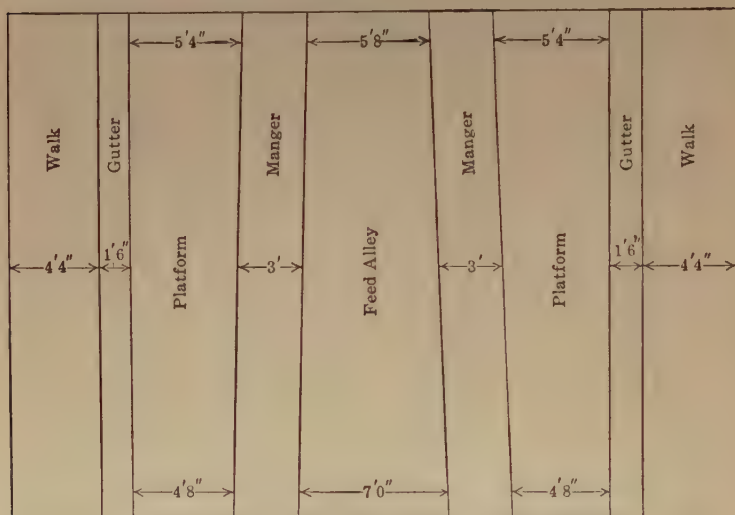


FIG. 109.—DIAGRAMMATIC FLOOR PLAN OF BARN

This plan shows a possible arrangement providing stall platforms of different sizes. With this arrangement, small cows (and yearling heifers also, if desired) are stanchioned, near one end of the barn, while the largest cows are placed near the other end.

A sub-floor of concrete, 3 to 4 inches thick, may first be laid in the stall, and then a floor of corkbrick or creosoted wood blocks, manufactured especially for this purpose, laid over this. The joints are filled in with an asphalt preparation. A retaining wall or curb of concrete, next the gutter, must also be constructed to hold the bricks or blocks in place.

Another effective device employed for the same purpose is to imbed in the concrete floor, next the manger curb, a 2 by 4-

inch or 2 by 6-inch strip. Planks are then laid lengthwise of the stall so that they completely cover the floor from manger to gutter and are nailed to the imbedded strip.

It is very important that the gutter be deep enough, so that the cows will not lie on the droppings. The floor of the gutter is usually 8 to 10 inches below the stall floor and 4 to 6 inches below the floor of the driveway or litter alley. The width of

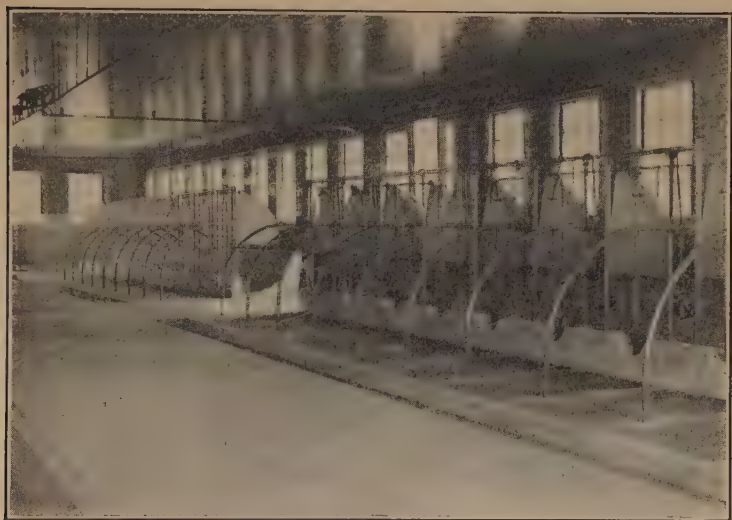


FIG. 110.—INTERIOR OF DAIRY BARN AT LOUISIANA STATE UNIVERSITY

One of the conspicuous features shown is the ample provision for light. The floor of each stall has been paved with an insulating material surrounded by a cement curb.

the gutter should be 16 to 18 inches. Gutters of different types are used satisfactorily. Unless sufficient bedding is used to absorb all the liquid manure, drains should be placed in the gutter and the floor of the gutter should slope 1 inch in 25 feet toward the drain.

E. Plan for housing of young stock.—Since the growing stock determines the future of the herd, provision must be made for their shelter also. Young calves are subject to pneumonia and

other diseases when housed in cold, drafty quarters. Pay special attention to securing comfortable calf pens and stanchions for yearlings.

In cold climates, young stock are best housed in the same stable as the cows, in order that the small calves, in particular, may be kept warm. Such an arrangement, however, may not be practicable in herds in which high-grade milk is being produced. If separate quarters are necessary, they should be

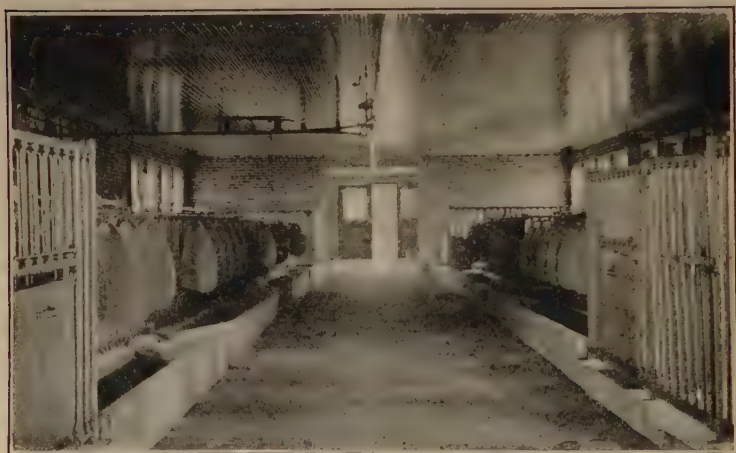


FIG. 111.—COW PENS AND CALF PENS IN LOUISIANA STATE UNIVERSITY BARN

Mangers that tilt out into the feed alley are shown in the cow pens in the foreground. Metal manger partitions in calf pens are shown raised for cleaning the mangers.

conveniently situated with respect to the milking herd in order to save labor in feeding and care.

Separate barns for young stock do not require so high a ceiling as do cow barns. In fact, the entire arrangement should be compact, so that the heat from the animals may warm the barn as much as possible.

The pens are convenient when arranged on both sides of a central feeding alley, extending from the alley to the side walls

of the barn. See Fig. 74. Gates may be placed in each of the pen divisions next the wall, to permit cleaning. This is a more economical use of space than to have alleys next the walls and through the center also.

F. Plan for maternity pens.—Arrange one box stall to be used as a maternity pen for every 12 to 15 cows in the herd. These pens may often be used for young stock also, but they should be available for the cows at calving time.

G. Provide sufficient light.—Few barns have too much light. Plenty of light helps to keep the barn sanitary and makes the surroundings pleasant for both the animals and their attendants. Four square feet of glass per cow or 1 square foot for each 20 square feet of floor space are standard guides for calculating the size of windows. In northern climates, double-glazed windows or storm sash are occasionally used to help keep the barn warm.

Locate the windows so that the light is uniformly distributed through the stable. Place them at least 4 feet above the floor in order to prevent breakage. They may be hinged at the bottom so that they open inward at the top to help provide ventilation.

H. Arrange for a good ventilation system.—Pay particular attention to the ventilation of the barn, especially if you live in a cold climate, for the health of the herd is very dependent upon it. Secure authoritative information on this subject from some of the sources mentioned.

I. Include a suitable milk room.—Do not overlook the location of a room suitable for weighing, straining, and cooling the milk. This room should be separated from the main part of the barn by a short passage having a swinging door at each end. If the milk is not to be cooled in the room where it is to be weighed and strained, plan a separate milk house with a cooling tank.

J. Arrange convenient exercising yards.—Plan for yards into which the cows can be turned on pleasant days in winter. Arrange these to the south of the barn or in a sheltered location.

Construct a separate yard for the small calves, preferably located in a sheltered, sunshiny place.

2. EQUIPPING THE BARN

During the past few years many improvements in equipment for dairy barns have been made. The most important of these are stalls and pens constructed of steel tubing. These are strong, durable, convenient, and neat, and have the added advantage over wooden equipment of being easily cleaned and disinfected. This kind of equipment is recommended whenever one can make the outlay necessary, and the suggestions given below are based upon the assumption that the barn is to be equipped in this way. For the dairyman who can not afford to provide steel equipment, for a few years at least, wooden stalls and pens, such as those shown in Fig. 79 are recommended.

Procedure:

- A. Install durable, sanitary equipment.
- B. Select swinging stanchions.
- C. Provide individual water bowls.
- D. Install litter carriers on tracks.
- E. Purchase or make feed trucks.

A. Install durable, sanitary equipment.—Before completing plans for the barn, consult some barn equipment company or its sales agency, regarding equipment. Where concrete floors and mangers are to be used, the steel tubing equipment must be set in the concrete as it is being poured. This equipment may also be used with wooden floors. Whichever construction is used, however, it is necessary to have complete plans and directions for installing the equipment before drawing final plans, so that provision may be made for curbs, stalls, etc., of the proper size.

B. Select swinging stanchions.—The swinging stanchion is preferable to the old-style rigid stanchion as it permits the animal much more freedom of movement. The stanchion may be all steel, steel with wood lining, or all wood. The steel stanchion is preferable on account of its neatness and strength.

C. Provide individual water bowls.—Equip the stalls with individual water bowls so that the cows may drink whenever



FIG. 112.—INTERIOR OF A WELL-EQUIPPED DAIRY BARN

The two rows of cows face in, or toward each other. Litter carriers are used to remove the manure. A feed carrier is employed to bring feed to the cows. The stalls are provided with name plates, and automatic water bowls, and are floored with an insulating material. Note the ventilator inlet flues in the ceiling above the feed alley, and at the right the large window sash which tilts inward at the top. A special feature of this barn is the raised feed alley, making manger fronts unnecessary.

they wish. Some water bowls are double and some single, but usually two cows may drink from a single bowl if it is placed between them. Slope the pipes so that they can be thoroughly drained on cold nights to prevent freezing.

D. Install litter carriers on tracks.—When the stalls are arranged so that there is a central feeding alley, install litter carriers on tracks for convenience in carrying the manure from

the barn to a manure spreader or pit outside. The lines of track should be placed so that the carriers will hang over the litter alley but close to the edge of the gutter. If several litter carrier loads are to be handled daily, the largest-sized carriers save time.

In barns in which the cows face out, litter carriers may also be used, instead of a manure spreader or wagon, to remove the manure. If this arrangement is used, two lines of carrier track are necessary.



FIG. 113.—INTERIOR OF BARN SHOWN IN FIG. 104
Mangers at the left have been raised for cleaning.

E. Purchase or make feed trucks.—If the floors or walks between the feed storage and the cow stable are smooth, use feed trucks for taking silage, concentrates, and in some cases hay, to the cows. In small herds, silage and concentrates may be carried in a basket.

Trucks designed especially for this purpose may be purchased. To construct a feed truck at home, proceed as follows: Make a strong box, 30 inches wide, 30 inches deep, and 5 to 6 feet long. Secure a pair of iron wheels, 10 to 18 inches in diameter, mounted on an iron pipe as an axle. Place the axle under the box about one-third the distance from one end. Under the

other end, on a swivel mounting, place an iron wheel about half the diameter of the other wheels.

GENERAL INFORMATION

Making common whitewash.—Slake quicklime with water at the rate of 10 pounds of lime to 2 gallons of water, allowing to stand one hour before using. Dilute to the desired consistency.

Whitewash—Government formula.—Slake $\frac{1}{2}$ bushel of quicklime with boiling water, covering to keep in steam. Strain through a fine sieve. Add a peck of salt previously dissolved in warm water, 3 pounds of ground rice boiled to a thin paste and stirred in while hot, and $\frac{1}{2}$ pound of Spanish whiting. Add 1 pound of glue dissolved by mixing with cold water, placing the kettle containing the mixture in a larger one filled with water, and then heating over a slow fire. Add 5 gallons of hot water, stir, cover and let stand a few days. This whitewash should be applied hot by means of a brush. One pint covers about one square yard and makes a durable coating. Coloring matter may be added if desired.

Making whitewash for cement walls.—Mix a few pounds of cement and mason's powdered lime in a pail in the proportions of 2 parts of lime to 1 part of cement by bulk, or about 4 pounds of lime to 5 pounds of cement. Mix with water to the consistency of thick cream, and apply with a brush.

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CHAPTER XIX

CARING FOR MANURE

Enormous losses of fertility occur on dairy farms each year through lack of care in saving the manure and applying it to the soil. While dairy farming offers one of the best means for conserving soil fertility and for building up run-down soils, little or no fertility will be added unless the manure is rightly cared for. It has been estimated that fully one-third of all manure produced in this country is lost through poor care, a loss amounting to millions of dollars annually.

The cow excretes from two-thirds to three-fourths of the fertilizing elements of her feed in the manure, about half of this amount being in the solid excrement, or dung, and about half in the liquid excrement, or urine. For this reason, both the liquid and the solid manure should be conserved, as far as possible.

Operations:

1. Collecting the manure.
2. Storing the manure.

1. COLLECTING THE MANURE

The suggestions given below apply to the care of manure produced while the cows are in the stable. That produced while the cows are at pasture is, of course, returned directly to the soil.

Procedure:

- A. Use enough bedding to absorb liquid manure.
- B. Remove manure from the stable by litter carrier or manure spreader.



FIG. 114.—REMOVING MANURE FROM THE BARN BY MEANS OF A LITTER CARRIER

The use of modern equipment greatly reduces the labor in the barn where there are many animals to be cared for.

A. Use enough bedding to absorb liquid manure.—The best way of saving the liquid manure and applying it to the soil is by the use of a large amount of dry bedding. Straw and

shredded corn stover are among the best materials for bedding, for they not only absorb the liquid manure readily, but also contain, in themselves, a large amount of the elements that make for fertility. Shavings, sawdust, refuse, hay, etc., may also be used. Bedding materials that are very dusty should not be used in barns where high-grade milk is being produced.

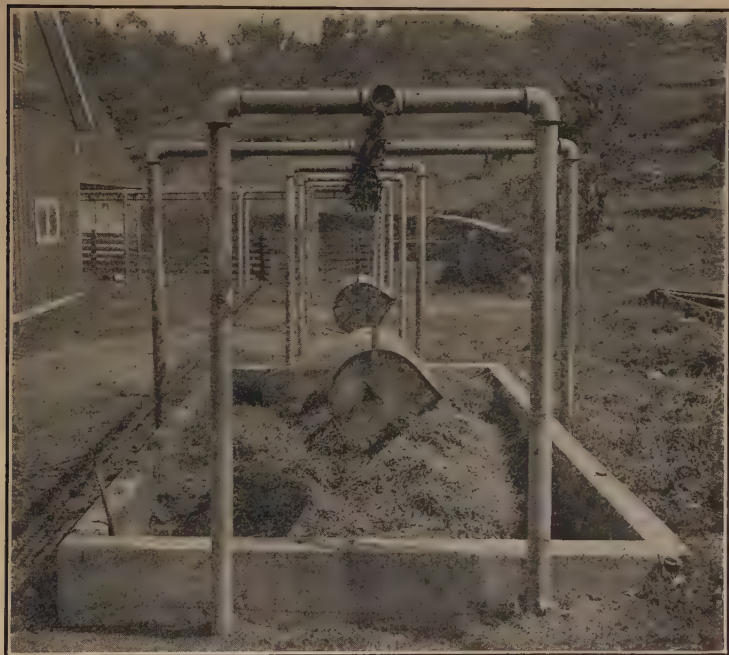


FIG. 115.—A CONCRETE MANURE PIT

This form of pit offers a good means of storing manure temporarily, for the concrete floor and walls prevent seepage in case of rain.

As a help in supplementing manure, raw rock phosphate is sometimes spread in small amounts in the gutters. The addition of this material not only increases the fertility value of the manure but also insures its becoming mixed with the manure, which is desirable if it is to be of value to the land.

Liquid manure may also be saved by collecting it in a cistern connected with the gutters in the stable by drains of sewer pipe (tile cemented at the joints). For sanitary reasons, the cistern should be 100 feet or more from the barn and should be kept tightly covered. It may be emptied by means of a pump and



FIG. 116.—A USELESS ATTEMPT TO SAVE MANURE

Any effort to conserve manure is commendable, but this manure pit constructed of fence posts can do little more than prevent the manure from being scattered. The rain and drainage water from the hill above will leach away much of its value.

tank wagon, and the liquid hauled to the fields and applied directly to growing crops.

B. Remove manure from the stable by litter carrier or manure spreader.—Remove the manure from the stable once or twice a day, loading it into either a litter carrier or a manure spreader. At the same time, distribute the bedding evenly in

the stalls, placing some in the gutters and adding fresh bedding if necessary.

2. STORING THE MANURE

The simplest method of handling manure, from the labor standpoint, is to haul it in a manure spreader to the fields each day, but for several reasons this is not always practicable. The

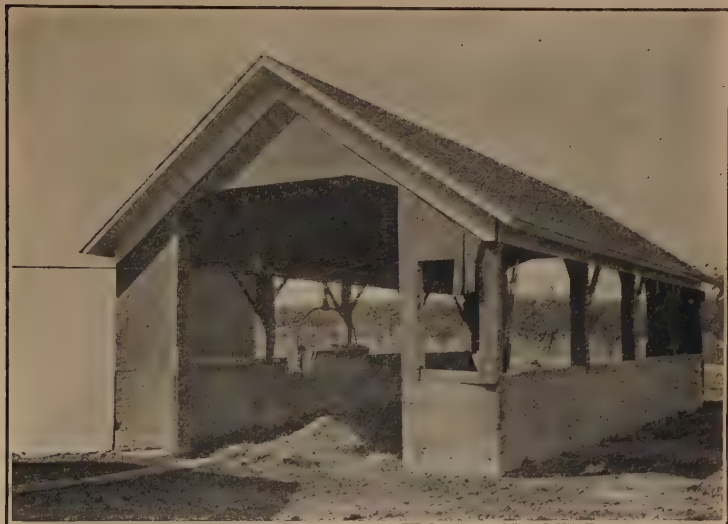


FIG. 117.—COVERED MANURE PIT FOR PRESERVING MANURE UNTIL IT CAN BE TAKEN TO THE FIELDS

Leaching away of the valuable elements of fertility by rain is prevented in a manure pit of this type. The manure may be loaded from the pit directly into a manure spreader driven along the open sides.

land may be such that if manure were applied during the winter much of it would wash away. The snow may be too deep, or the ground too soft, to permit the use of the manure spreader. In such cases, good storage should be provided, for rain rapidly leaches away much of the value of the manure if it is left in an exposed pile.

Procedure:

A. Store the manure under cover.

B. Keep the manure compact and moist.

A. Store the manure under cover.—A common method of storing manure in some sections is to push it through trap-doors in the gutters into a basement below. This is a simple method of handling and storing, but it has disadvantages from the sanitary standpoint.

A better method of caring for manure, as it is removed from the barn, is to store it in a covered shed or pit 50 feet or more from the barn. It can then be removed to the fields when desired.

B. Keep the manure compact and moist.—In storing manure, place it in a deep pile to make it compact and to help retain its moisture. If necessary in hot weather, add enough water to prevent fermentation, as losses of nitrogen occur if fermentation takes place. Such losses may be partly prevented by sprinkling a small amount of gypsum over the manure. The use of gypsum also helps to destroy the odor of the manure while in storage.

GENERAL INFORMATION**1. NUTRIENT ELEMENTS OF PLANT GROWTH**

There are ten elements of plant food that are known to be essential to the growth and formation of every plant. Three of these are supplied by air and water, and seven must be derived from the soil.

Supplied by Air and Water	Derived from the Soil
1. Carbon	1. Nitrogen *
2. Hydrogen	2. Phosphorus *
3. Oxygen	3. Sulphur
	4. Potassium *
	5. Magnesium
	6. Calcium *
	7. Iron

* Elements which most frequently limit crop yields.

A. Plant food elements found in farm crops.—When a given weight of a certain crop is taken from the soil, there is removed from that soil in that crop certain elements of plant food. Unless provision is made for the return of those elements the soil becomes gradually depleted. Table XVIII shows the weight of each of the seven elements of plant food supplied by the soil and found in different amounts in our common crops.

TABLE XVIII
PLANT-FOOD ELEMENTS IN COMMON FARM CROPS

Produce		Nitro- gen	Phos- phorus	Sul- phur	Potas- sium	Mag- nesium	Cal- cium	Iron
Kind	Amount							
		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Wheat, grain.....	1 bu.	1.42	.24	.10	.26	.08	.02	.01
Wheat, straw....	1 ton	10.00	1.60	2.80	18.00	1.60	3.80	.60
Corn, grain.....	1 bu.	1.00	.17	.08	.19	.07	.01	.01
Corn stover.....	1 ton	16.00	2.00	2.42	17.33	3.33	7.00	1.60
Corn cobs.....	1 ton	4.00	.....	.....	4.00			
Oats, grain.....	1 bu.	.66	.11	.06	.16	.04	.02	.01
Oat straw.....	1 ton	12.40	2.00	4.14	20.80	2.80	6.00	1.12
Clover seed.....	1 bu.	1.75	.50	....	.75	.25	.13	
Clover hay.....	1 ton	40.00	5.003	3.28	30.00	7.75	29.25	1.00
Soybean seed....	1 bu.	3.22	.39	.27	1.26	.15	.14	
Soybean hay.....	1 ton	43.40	4.74	5.18	35.48	13.84	27.56	
Alfalfa hay.....	1 ton	52.08	4.76	5.96	16.64	8.00	22.26	

These data have been brought together from various sources. Some allowance must be made for the exactness of the figures because samples representing the same kind of crop or the same kind of material frequently show considerable variation.

Using the values supplied by the above table, we find that a 75-bushel crop of corn, in grain only, removes from the soil 75 pounds of nitrogen, 12.75 pounds of phosphorus, 6.00 pounds of sulphur, 14.25 pounds of potassium, 5.25 pounds of mag-

nesium, and .75 pound each of calcium and iron. When the stalks are also removed a very much greater loss is incurred.

B. Plant food elements in manure.—Table XIX gives the elements of plant food found in manure and in some of our more common roughages.

TABLE XIX
PLANT-FOOD ELEMENTS IN MANURE AND ROUGHAGES

Material	Pounds of Plant Food per Ton of Material		
	Nitrogen	Phosphorus	Potassium
Fresh farm manure.....	10	2	8
Corn stover.....	16	2	17
Oat straw.....	12	2	21
Wheat straw.....	10	2	18
Clover hay.....	40	5	30
Cowpea hay.....	43	5	33
Alfalfa hay.....	50	4	24
Sweet clover (water-free basis) *	80	8	28

* Second year's growth ready to plow under as green manure.

In restoring the plant food removed by the 75-bushel corn crop referred to above, it would be necessary to apply 7.5 tons of manure to supply the nitrogen, although 3 tons would be sufficient to provide the phosphorus and 2 tons to supply the potassium removed. In all probability it would not be necessary to consider the remaining four elements, except possibly calcium in case legumes are to be extensively grown.

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COMMUNITY STUDIES

Visit several representative dairy farms in your community, both good and poor, and study the methods used in caring for the manure.

1. Is a special effort made to save liquid manure, and if so, what methods are used?
2. What kind of bedding is used?
3. How is manure removed from the stable?
4. How often is manure removed?
5. How often is fresh bedding added?
6. Is manure taken directly to the fields?
7. If manure is stored, what are the arrangements for storage?
8. If manure pit or shed is used, what are its dimensions, construction, and distance from barn?
9. How often is manure removed from storage?
10. Are any special precautions taken to preserve the manure (compacting, moistening, adding gypsum, etc.)?
11. Is any other material added to the manure to increase its value or to help preserve it (rock phosphate, gypsum, etc.)?

APPENDIX

TABLE XX

RULES FOR COMPUTING AMOUNTS OF FEED AND BEDDING IN STORAGE

Mows and stacks.—Hay that has settled not more than thirty days occupies about 590 cu. ft. of space per ton, either in the mow or in the stack; but after settling from 75 to 155 days it occupies only about 515 cu. ft. per ton.

Loose straw in a mow or stack occupies from 600 to 900 cu. ft. per ton. Loose sawdust and baled shavings occupy from 150 to 160 cu. ft. per ton.

Corn cribs.—Calculate the number of cubic feet occupied by ear corn by multiplying together the numbers representing the length and width of the crib, and the average depth of the corn. Multiply the product by $\frac{2}{3}$, or multiply by 4 and divide by 10. The result is in terms of "bushels" of ear corn. Seventy pounds of dry ear corn is usually considered equivalent to one bushel of shelled corn.

Bins.—To find the amount of feed in a bin in terms of bushels, multiply together the numbers representing the length and width of the bin, and the average depth of the feed in the bin. Divide this product by 1.25, or multiply by 0.8.

The amount of feed in terms of bushels may be converted to equivalent amounts in terms of pounds by the use of the values given below. For example, it has been found that a bin contains 150 bu. of wheat bran in bulk, and it is desired to convert this value into pounds. The figures below indicate that one bushel of wheat bran weighs 18 pounds. Therefore, $18 \times 150 = 2700$, which represents the amount of bran in pounds.

TABLE XX *Continued*

WEIGHT AND VOLUME OF VARIOUS FEEDS *

(Approximate values only. Weight varies with quality of feed, fineness of grinding, etc.)

Feed	1 Quart Weights Pounds	1 Bushel Weights Pounds	1 Pound Measures Quarts	100 Pounds Measures Bushels
Alfalfa meal.....	0.6	19	1.7	5.3
Barley.....	1.5	48	0.7	2.0
Barley, ground.....	1.1	35	0.9	2.8
Beans, navy.....	1.9	60	0.5	1.7
Beet pulp, dried.....	0.7	21	1.5	4.8
Coconut cake.....	1.3	42	0.8	2.4
Coconut meal.....	1.5	47	0.7	2.1
Corn, shelled.....	1.8	56	0.6	1.8
Corn, ground.....	1.3	42	0.8	2.4
Corn germ meal.....	1.4	43	0.7	2.3
Corn gluten feed.....	1.5	48	0.7	2.0
Corn gluten meal.....	1.7	53	0.6	1.9
Corn hominy feed.....	1.5	48	0.7	2.0
Corn-and-cob meal.....	1.5	48	0.7	2.0
Cottonseed.....	0.8	25	1.3	4.0
Cottonseed hulls.....	0.3	11	2.9	9.2
Cottonseed meal (high-grade).....	1.8	56	0.9	1.8
Cottonseed meal (low-grade).....	1.6	50	0.6	2.0
Cowpea seed.....	1.7	54	0.6	1.9
Flaxseed.....	1.7	53	0.6	1.9
Flaxseed, ground.....	1.1	35	0.9	2.8
Linseed oil meal, N. P.....	1.2	38	0.8	2.6
Linseed oil meal, O. P.....	1.3	42	0.8	2.4
Molasses, cane or blackstrap.....	3.0	.....	0.3	.....
Oats, whole.....	1.0	32	1.0	3.1
Oats, ground.....	0.7	22	1.4	4.4
Peas, field.....	2.1	67	0.5	1.6
Rye, whole.....	1.7	56	0.6	1.8
Rye, ground.....	1.5	48	0.7	2.0
Rye middlings.....	1.6	50	0.6	2.0
Soybean seed.....	1.9	60	0.5	1.7
Wheat, whole.....	1.9	60	0.5	1.7
Wheat, ground.....	1.7	54	0.6	1.9
Wheat bran.....	0.6	18	1.8	5.7
Wheat middlings, std.....	1.0	32	1.0	3.1

* Adapted from U.S.D.A. Farmers' Bul. 222, Ind. Exp. Sta. Bul. 141, and Ill. Legal Weights and Measures.

TABLE XXI

AMOUNTS OF CORN SILAGE WHICH SILOS OF DIFFERENT SIZES WILL HOLD, AND METHOD OF ESTIMATING THE AMOUNT OF SILAGE IN PARTLY EMPTIED SILO *

Depth of Silage in Feet When Filling Ceased	Diameter of Silo in Feet								
	10	11	12	13	14	15	16	17	18
1	.63	.77	.95	1.07	1.24	1.42	1.62	1.83	2.06
2	1.33	1.60	1.91	2.24	2.60	2.98	3.40	3.88	4.31
3	2.07	2.52	2.99	3.51	4.15	4.67	5.32	6.01	6.74
4	2.88	3.49	4.16	4.88	5.66	6.50	7.39	8.35	9.37
5	3.75	4.54	5.40	6.33	7.35	8.44	9.65	10.85	12.18
6	4.68	5.65	6.71	7.89	9.15	10.52	11.96	13.52	15.16
7	5.64	6.84	8.12	9.54	11.07	12.70	14.45	16.32	18.32
8	6.68	8.03	9.60	11.27	13.06	15.00	17.08	19.30	21.64
9	7.75	9.38	11.16	13.09	15.17	17.43	19.84	22.42	25.14
10	8.84	10.76	12.78	15.44	17.40	19.96	22.72	25.69	28.78
11	10.08	12.16	14.48	16.98	19.70	22.62	25.72	29.08	32.60
12	11.30	13.64	16.25	19.05	22.10	25.36	28.89	32.64	36.57
13	12.53	15.18	18.07	21.20	24.60	28.24	32.22	36.32	40.67
14	13.90	16.89	20.00	23.46	27.20	31.22	35.54	40.18	44.97
15	15.24	18.45	21.96	25.76	29.90	34.53	39.08	44.10	49.40
16	16.75	20.19	24.00	28.16	32.68	37.50	42.67	48.40	54.00
17	18.12	21.95	26.11	31.30	35.50	40.68	46.39	52.45	58.75
18	19.60	23.77	28.28	33.30	38.45	44.19	50.27	56.75	63.61
19	21.16	25.62	30.49	35.75	41.50	47.68	54.05	61.25	68.64
20	22.78	27.55	32.75	38.45	44.60	51.23	58.28	65.83	73.80
21	24.40	29.52	35.14	41.23	47.80	54.90	62.48	70.54	79.13
22	25.96	31.54	37.54	44.05	51.10	58.80	66.70	75.32	84.48
23	27.14	33.61	40.00	46.95	54.40	62.50	71.80	80.30	90.00
24	29.50	35.67	42.45	49.85	57.80	66.30	75.48	85.27	95.53
25	31.30	37.85	45.20	52.83	61.30	70.38	80.00	90.36	101.25
26	33.08	40.00	47.66	55.45	64.80	74.40	84.64	95.54	107.22
27	34.92	42.21	50.28	59.00	68.40	78.62	89.30	100.85	113.20
28	36.78	44.50	53.00	62.13	72.10	82.80	94.10	106.25	119.25
29	38.67	46.80	55.75	65.31	75.80	87.10	98.90	111.75	125.40
30	40.60	49.16	58.50	68.60	79.50	91.30	103.80	117.30	131.60
31	.....	.....	61.27	71.90	83.37	95.75	108.80	122.90	137.90
32	.....	.....	64.12	75.20	87.20	100.20	113.80	128.60	144.35
33	.....	.....	67.00	78.50	91.10	104.60	118.90	134.40	150.80
34	.....	.....	69.82	82.10	95.10	109.20	124.20	140.25	157.35
35	.....	.....	.....	.....	99.10	113.80	129.30	146.10	163.90
36	.....	.....	.....	.....	103.20	118.50	134.70	152.15	170.70
37	.....	.....	.....	.....	107.20	123.10	139.90	158.15	177.40
38	.....	.....	.....	.....	111.30	127.80	145.30	164.20	184.20
39	.....	.....	.....	.....	115.50	132.60	150.80	170.30	191.20
40	.....	.....	.....	.....	119.60	137.40	156.20	176.40	198.10
41	.....	.....	.....	.....	123.80	142.20	161.70	182.70	205.10
42	.....	.....	.....	.....	128.20	147.20	167.40	189.00	212.05
43	.....	.....	.....	.....	.....	152.00	172.90	195.30	219.20
44	.....	.....	.....	.....	.....	.....	178.60	201.80	226.30
45	.....	.....	.....	.....	.....	.....	184.20	208.20	233.60
46	.....	.....	.....	.....	.....	.....	190.00	214.70	240.85
47	.....	.....	.....	.....	.....	.....	195.80	221.30	248.20
48	.....	.....	.....	.....	.....	.....	201.80	227.90	255.65
49	.....	.....	.....	.....	.....	.....	207.70	234.50	263.20
50	.....	.....	.....	.....	.....	.....	213.60	241.20	270.75

* Adapted from Nebr. Agr. Exp. Sta. Cir. 1. This table is based on the assumption that the corn was well tamped during the filling process and that the silo was refilled after the silage had settled for a few days.

Method of estimating the amount of silage in a silo after it has been partly emptied.—Find from the above table the amount of

silage in the silo at the time filling ceased. Then find the capacity of the space in the silo that has been emptied, and subtract this amount from the first. The difference is the estimated amount of silage remaining in the silo. For example, a silo 16 feet in diameter was filled to a depth of 36 feet, and there remains 12 feet of silage in the bottom of the silo. The table shows that 134.7 tons of silage was put into the silo, and that a depth of 24 feet ($36 - 12 = 24$) in a silo of this diameter would hold 75.5 tons. The difference, 59.2, represents the number of tons of silage remaining in the silo.

TABLE XXII
SIMPLE CLASSIFICATION OF FEEDS *

Palatable Feeds

<i>Roughages</i>	<i>Concentrates</i>	
Corn silage	Barley	Molasses
Fresh green roughages	Beet pulp	Oats
Legume hays, when in good condition	Corn	Wheat
	Hominy feed	Wheat bran
Roots and tubers, pumpkins, etc.	Linseed oil meal	Wheat middlings

Laxative Feeds

<i>Roughages</i>	<i>Concentrates</i>	
Corn silage	Flaxseed meal	Soybeans
Fresh green roughages	Linseed oil meal	Soybean oil meal
Legume hays	Molasses	Wheat bran
Roots and tubers		

Constipating Feeds

<i>Roughages</i>		<i>Concentrates</i>
All hays except the legumes	Corn	Cottonseed meal
Corn stover		
Straw from the cereal grains		

Bulky Feeds

<i>Roughages</i>	<i>Concentrates</i>	
All roughages	Alfalfa meal	Hulls of various seeds
	Beet pulp	Oats, ground
	Buckwheat bran	Rye bran
	Corn bran	Wheat bran

TABLE XXII *Continued***High-protein Feeds**

<i>Roughages</i>	<i>Concentrates</i>
All legume hays (as compared with nearly all non-legume roughages)	Buckwheat mid- dlings
	Coconut meal
	Corn germ meal
	Corn gluten feed
	Corn gluten meal
	Cottonseed meal
	Cowpea seed
	Flaxseed meal
	Linseed oil meal
	Peanut oil meal
	Peanuts
	Peas and beans
	Skim milk, dried
	Soybean oil meal
	Soybeans
	Wheat bran
	Wheat middlings

Low-protein Feeds

<i>Roughages</i>	<i>Concentrates</i>
Nearly all non-legume roughages, including pumpkins, roots and tubers, etc.	Barley
	Beet pulp
	Buckwheat
	Corn
	Corn-and-cob meal
	Emmer
	Hominy feed
	Kafir grain
	Milo grain
	Molasses
	Oats
	Rye
	Skim milk, fresh
	Wheat

* Adapted from Ill. Agr. Exp. Sta. Cir. 272.

TABLE XXIII

DATA FROM WHICH THE COST OF DIGESTIBLE PROTEIN IN VARIOUS FEEDS
MAY BE ESTIMATED, USING CORN AS A BASE *

"Excess Protein" per Ton, Pounds	Feed	"Corn Value" of 1 Ton of Feed Named When the Price of Corn per Bushel is—						
		30c.	40c.	50c.	60c.	70c.	80c.	90c.
45	Barley.....	\$9.65	\$12.87	\$16.09	\$19.31	\$22.53	\$25.74	\$28.95
0	Corn.....	10.71	14.29	17.86	21.43	25.00	28.57	32.13
319	Corn gluten feed.....	8.10	10.80	13.50	16.20	18.90	21.60	24.30
501	Corn gluten meal.....	7.37	9.83	12.29	14.84	17.20	19.66	22.11
661	Cottonseed meal, choice..	5.64	7.52	9.40	11.28	13.17	15.05	16.92
587	Cottonseed meal, prime..	5.78	7.70	9.63	11.55	13.48	15.40	17.34
555	Cottonseed meal, good..	5.88	7.84	9.80	11.76	13.72	15.68	17.64
279	Cowpea seed.....	7.80	10.40	13.00	15.60	18.20	20.80	23.40
-9	Hominy feed.....	10.64	14.19	17.73	21.28	24.83	28.37	31.92
512	Linseed oil meal, O. P..	6.55	8.73	10.91	13.09	15.27	17.46	19.65
78	Oats.....	8.31	11.09	13.86	16.63	19.40	22.17	24.93
61	Skim milk.....	.76	1.01	1.27	1.52	1.77	2.03	2.28
708	Soybean oil meal.....	6.14	8.18	10.23	12.27	14.32	16.36	18.41
508	Soybean seed.....	7.56	10.09	12.61	15.13	17.65	20.17	22.68
48	Wheat.....	9.71	12.94	16.18	19.41	22.65	25.88	29.12
157	Wheat bran.....	6.63	8.84	11.05	13.26	15.48	17.69	19.89
161	Wheat middlings, standard.....	7.66	10.21	12.77	15.32	17.87	20.43	22.98

* From Ill. Agr. Exp. Sta., Cir. 272.

Directions for using the above table:

1. Find the "corn value" of the feed under consideration.
2. Subtract the "corn value" from the price of the feed per ton.
3. Divide this remainder by the number of pounds of "excess protein."
4. This quotient is the cost of 1 pound of digestible protein in that feed.

Example

When corn is worth 60 cents per bushel, will cottonseed meal, prime at \$50 per ton, furnish digestible protein more cheaply than wheat bran at \$25 per ton?

Price of cottonseed meal, per ton.....	\$50.00
"Corn value" of cottonseed meal.....	11.55

Difference (cost of "excess protein" in 1 ton) \$38.45

TABLE XXIII *Continued*

" Excess protein " in cottonseed meal (see table) 587 lbs.

\$38.45 divided by 587 equals \$.0655, which is the cost of 1 pound of digestible protein in cottonseed meal, prime, when allowance is made for the value of the nutrients other than protein in terms of their value in corn.

Price of wheat bran, per ton	\$25.00
------------------------------------	---------

" Corn value " of wheat bran	13.26
------------------------------------	-------

Difference (cost of " excess protein " in 1 ton)...	\$11.74
---	---------

" Excess protein " in wheat bran (see table).....157 lbs.

\$11.74 divided by 157 equals \$.0748, which equals the cost per pound of digestible protein in wheat bran on corn basis.

Cost of 1 pound of digestible protein in wheat bran	\$.0748
---	---------

Cost of 1 pound of digestible protein in cotton seed meal.....	.0655
--	-------

Difference	\$.0093
------------------	----------

At the prices given, therefore, cottonseed meal at \$50 per ton is a cheaper source of digestible protein than wheat bran at \$25 per ton.

TABLE XXIV
MINERAL CONTENT OF FEEDS *

Feed	Dry Matter, Per Cent	Total Ash, Per Cent	Potas- sium, Per Cent	Calcium, Per Cent	Mag- nesium, Per Cent	Phos- phorus, Per Cent
Alfalfa hay.....	92.58	6.38	0.770	1.046	0.370	0.221
Beans, navy.....	85.51	3.78	1.186	0.201	0.176	0.367
Beet pulp, dried....	90.47	2.91	0.314	0.660	0.256	0.062
Bluegrass hay.....	91.71	4.82	1.290	0.308	0.220	0.222
Clover hay.....	92.43	6.76	1.701	1.142	0.270	0.169
Corn.....	85.76	1.21	0.340	0.012	0.108	0.260
Corn gluten feed....	92.01	3.18	0.250	0.247	0.220	0.542
Corn stover.....	93.04	6.52	1.718	0.472	0.086	0.095
Cottonseed meal....	91.42	6.98	1.656	0.266	0.548	1.352
Cowpeas.....	85.76	3.69	1.403	0.100	0.208	0.456
Cowpea hay.....	89.38	10.76	0.780	1.814	0.980	0.253
Kafir corn, grain....	88.11	1.18	0.254	0.012	0.125	0.239
Linseed oil meal....	89.66	5.80	1.098	0.362	0.488	0.705
Mangel wurzel.....	11.46	1.18	0.444	0.015	0.041	0.030
Milk, skim.....	9.59	0.69	0.122	0.128	0.014	0.094
Millet hay.....	95.11	5.60	1.273	0.310	0.249	0.165
Oats.....	91.11	3.38	0.419	0.102	0.118	0.395
Soybeans.....	91.37	5.06	1.913	0.210	0.223	0.592
Soybean hay.....	89.39	7.67	1.586	1.232	0.619	0.212
Timothy hay.....	91.94	3.20	0.564	0.177	0.102	0.113
Wheat.....	87.69	1.64	0.520	0.050	0.130	0.373
Wheat bran.....	89.98	6.06	1.320	0.125	0.531	1.110
Wheat middlings....	88.98	4.12	1.021	0.096	0.383	0.876
Whey.....	6.04	0.56	0.167	0.044	0.008	0.039

* Ohio Agr. Exp. Sta., Bul. 255.

TABLE XXV
MINERAL REQUIREMENTS FOR MILK PRODUCTION *
Amounts of Minerals to Be Supplied in the Feed

	Lime (CaO)		Phosphoric Acid (P ₂ O ₅)	
	Grams	Oz.	Grams	Oz.
For maintenance of 1000-lb.				
cow.....	45	or 1.6	23	or 0.8
For 100 lbs. of milk.....	205	or 7.2	170	or 6.0

* Adapted from Kellner, "The Scientific Feeding of Farm Animals." Kellner's figures are based on the assumption that not more than one-third to one-half of the lime and phosphorus in the feed is utilized. He estimates the mineral content of milk as 7.4 grams per 100 lbs., of which 1.8 grams are lime (CaO) and 1.5 grams are phosphoric acid (P₂O₅).

TABLE XXVI

AMOUNTS OF VITAMINS A AND B IN FARM FEEDS AND FARM PRODUCTS *

—	indicates a lack of information and of any safe basis for estimating the vitamin content
0	indicates no appreciable amounts of vitamin
+	} indicate increasing amounts of vitamin
++	
+++	
++++	
+++++	
★	indicates an exceptionally large amount of vitamin
?	indicates that the vitamin content may be higher than the estimate given.

	Vitamin A	Vitamin B
Green forage, dried		
Alfalfa.....	★	++++
Clover.....	★	++++
Timothy.....	★	++++

Grains and seeds

Barley.....	+	+++
Corn, white.....	0	++++
Corn, yellow.....	++	++++
Millet.....	0 to +	—
Oats.....	0 to +	+++
Peanuts.....	+	++++
Peas, yellow.....	++	+++
Peas, green.....	+++	+++
Rye.....	+	—
Soybeans.....	+++	+++
Wheat.....	+	++++

Seeds, green sprouted

Content of vitamins A and C increased as compared with ungerminated seed.

By-products of seeds

Cottonseed meal.....	+	+++
Soybean meal.....	++	+++
Coconut meal.....	++	+++
Wheat bran.....	++	+++
Wheat flour, white.....	0	+
Wheat germ.....	++(?)	★
Gluten feed.....	0 (?)	0
Rice, polished.....	0	0
Rice bran.....	0	★

TABLE XXVI—*Continued*

	Vitamin A	Vitamin B
Roots and tubers, dried		
Carrots, yellow.....	★	+++++
Carrots, white.....	0 to +	+++++
Rutabagas.....	+	+++++
Potatoes, white.....	+	+++
Sweet potatoes, yellow.....	+++++	++
Sweet potatoes, white.....	+	—
Sugar beets.....	0	0 to +
Red beets.....	0	0 to +
Sugar mangels.....	0	0 to +
Animal products, dried		
Milk, whole.....	+++++(?)	+++
Milk, skim.....	++	+++
Tankage.....	0 to +	0
Blood meal.....	0	0
Fish meal.....	0	0
Miscellaneous		
Yeast.....	0	★
Tomatoes, dried.....	★	+++-+
Molasses.....	0	0
Cod-liver oil.....	★	0

* Ill. Agr. Exp. Sta., Cir. 282.

TABLE XXVII

DIGESTIBLE NUTRIENTS IN 100 POUNDS OF VARIOUS DAIRY FEEDS *

Feed	Total Dry Matter in 100 Lbs.	Digestible Nutrients in 100 Lbs.		Nutrient Ratio † 1 :
		Crude protein	Total	
CONCENTRATES				
Barley.....	Lbs. 90.7	Lbs. 9.0	Lbs. 79.4	8.8
Bean, navy.....	86.6	18.8	71.9	3.8
Beet pulp, dried.....	91.8	4.6	71.6	15.6
Coconut meal or cake, old process.....	89.8	18.6	78.8	4.2
Corn, dent, well cured.....	89.5	7.5	85.7	11.4
Corn-and-cob meal.....	89.6	6.1	78.1	12.8
Corn germ meal.....	91.1	16.5	82.5	5.0
Corn gluten feed.....	91.3	21.6	80.7	3.7
Corn gluten meal.....	90.9	30.2	84.0	2.8
Cottonseed meal, choice.....	92.5	37.0	78.2	2.1
Cottonseed meal, prime.....	92.2	33.4	75.5	2.3
Cottonseed meal, good.....	92.1	31.6	74.8	2.4
Cottonseed feed.....	91.7	14.2	57.7	4.1
Cottonseed hulls.....	90.3	0.3	37.0	123.3
Cowpea seed.....	88.4	19.4	76.4	3.9
Flax screenings.....	91.4	11.1	69.6	6.3
Hominy feed.....	89.9	7.0	84.6	12.1
Kafir grain.....	88.2	9.0	80.0	8.9
Linseed oil meal, new process.....	90.4	31.7	75.9	2.4
Linseed oil meal, old process.....	90.9	30.2	77.9	2.6
Molasses, cane, or blackstrap.....	74.3	1.0	59.5	9.5
Oats.....	90.8	9.7	70.4	7.3
Pea, field.....	90.8	19.0	76.2	4.0
Peanut oil meal, from shelled nuts.....	93.4	40.3	83.5	2.1
Rye.....	90.6	9.9	81.0	8.2
Soybean oil meal.....	89.5	39.7	84.5	2.1
Soybean seed.....	90.1	33.2	94.1	2.8
Velvet bean, seed.....	88.3	18.1	80.8	4.5
Wheat.....	89.8	9.2	80.1	8.7
Wheat bran.....	89.9	12.5	60.9	4.9
Wheat middlings, standard.....	89.5	13.4	69.3	5.2
ROUGHAGES				
Alfalfa hay.....	91.4	10.6	51.6	4.9
Blue grass hay.....	86.8	4.7	51.6	11.0
Clover, red, hay.....	87.1	7.6	50.9	6.7
Clover, alsike, hay.....	87.7	7.9	47.3	6.0
Clover, sweet, hay.....	91.4	10.9	50.7	4.7
Corn silage, well matured.....	26.3	1.1	17.7	16.1
Corn stover, medium, in water.....	81.0	2.1	46.1	22.0
Corn stover, green (ears removed).....	22.7	0.5	12.9	25.8
Cowpea hay.....	90.3	13.1	49.0	3.7
Cowpea straw.....	91.5	3.4	44.1	13.0
Lespedeza or Japan clover hay.....	88.2	8.6	52.2	6.1
Millet, common, or Hungarian, hay....	85.7	5.0	55.0	11.0
Oat hay.....	88.0	4.5	46.4	10.3
Prairie hay, western.....	93.5	4.0	47.9	12.0
Redtop hay.....	90.2	4.6	53.2	11.6
Soybean hay.....	91.4	11.7	53.6	4.6
Soybean straw.....	88.1	2.8	43.5	15.5
Sunflower silage.....	21.9	1.0	12.6	12.6
Timothy hay.....	88.4	3.0	48.5	16.2
Vetch, hairy, hay.....	87.7	15.7	57.1	3.6
ROOTS				
Beet, common.....	13.0	0.9	10.2	11.3
Beet, sugar.....	16.4	1.2	14.0	11.7
Carrot.....	11.7	1.0	10.6	10.6
Mangel.....	9.4	0.8	7.4	9.2
Potato.....	21.2	1.1	17.1	15.5
Rutabaga.....	10.9	1.0	9.4	9.4
Turnip.....	9.5	1.0	7.4	7.4

* These data are taken, by special permission of the authors, from the extensive tables in "Feeds and Feeding," by Henry and Morrison, 18 ed., 1923.

† Nutrient ratio = nutritive ratio + 1.

TABLE XXVIII

THE MORRISON FEEDING STANDARD FOR DAIRY COWS *

	Digestible Crude Protein, Pounds	Total Digestible Nutrients, Pounds
For maintenance of 1000-lb. cow.	0.700	7.925
<i>To allowance for maintenance add:</i>		
For each lb. of 3.0 per cent milk.	0.047 - 0.057	0.257 - 0.286
For each lb. of 3.5 per cent milk.	0.049 - 0.061	0.284 - 0.316
For each lb. of 4.0 per cent milk.	0.054 - 0.065	0.311 - 0.346
For each lb. of 4.5 per cent milk.	0.057 - 0.069	0.338 - 0.376
For each lb. of 5.0 per cent milk.	0.060 - 0.073	0.362 - 0.402
For each lb. of 5.5 per cent milk.	0.064 - 0.077	0.385 - 0.428
For each lb. of 6.0 per cent milk.	0.067 - 0.081	0.409 - 0.454

* Henry and Morrison, *Feeds and Feeding*, 18th ed., Appendix, Table V.

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